VPDES PERMIT FACT SHEET

This document gives pertinent information concerning the reissuance of the VPDES permit listed below. This permit is being processed as a Minor, Municipal permit. The effluent limitations contained in this permit will maintain the Water Quality Standards (WQS) of 9 VAC 25-260. The discharge results from the treatment of municipal wastewater. This permit action consists of reissuing the permit with revisions to the permit, as needed, due to changes in applicable laws, guidance, and available technical information.

1. Facility Name and Address:
   Crooked Run STP
   130 Crappie Court
   Front Royal, VA 22630
   Location: 130 Crappie Court
   SIC Code: 4952 - Sewerage Systems

2. Permit No. VA0080080
   Expiration Date: December 1, 2007

3. Owner Contact: Name: Jesse Moffett
   Title: Executive Director
   Telephone No: 540-722-3579

4. Application Complete Date: December 30, 2008

   Permit Drafted By: Jason Dameron — Date: March 5, 2009
   Reviewed By: Eric Millard — Date:
   Brandon Kiracofe — Date:

   Public Comment Period: May 18, 2009 to June 17, 2009

5. Annual Permit Maintenance Fee per 9 VAC 25-20-142: $1,500.00
   VPDES Municipal Minor / Greater Than 100,000 GPD
   Highest Permitted Flow: 0.625 MGD TMP? No > 5 outfalls? No

6. Receiving Stream Name: Crooked Run — River Mile: 8.96
   Basin: Potomac — Subbasin: Shenandoah
   Section: 1c — Class: IV
   Special Standards: pH
   Impaired? Yes — Tidal Waters? No
   Watershed Name: VAN-B56R Crooked Run

7. Operator License Requirements per 9 VAC 25-31-200.C: II

8. Reliability Class per 9 VAC 25-790: II (Assigned December 14, 1988)

9. Permit Characterization:

   ☐ Private ☐ Federal ☐ State ☑ POTW ☐ PVOTW
   ☐ Possible Interstate Effect ☐ Interim Limits in Other Document (attach copy of CSO)

Introduction

10. Description of Treatment Works Treating Domestic Sewage: **Appendix A**

    Total Number of Outfalls = 1

    Operation and Maintenance (O&M) Manual: Approved March 19, 2007

11. Discharge Location Description and Receiving Waters Information: **Appendix B**

    Topo Map Name: Stephens City Topo Map Number: 217C

12. Antidegradation Review & Comments per 9 VAC 25-260-30: Tier: 1

    The State Water Control Board's Water Quality Standards (WQS) includes an antidegradation policy. All state surface waters are provided one of three levels of antidegradation protection. For Tier 1 or existing use protection, existing uses of the water body and the water quality to protect these uses must be maintained. Tier 2 water bodies have water quality that is better than the water quality standards. Significant lowering of the water quality of Tier 2 waters is not allowed without an evaluation of the economic and social impacts. Tier 3 water bodies are exceptional waters and are so designated by regulatory amendment. The antidegradation policy prohibits new or expanded discharges into exceptional waters.

    The antidegradation review begins with a Tier determination. Crooked Run is determined to be a Tier 1 waterbody because there is no stream flow at the discharge point during critical flow conditions. Antidegradation baselines are not calculated for Tier 1 waters.

13. Site Inspection: Performed by: Susan Shifflett Date: September 17, 2008

14. Effluent Screening and Effluent Limitations: **Appendix C**

15. Management of Sewage Sludge:
    Stabilized dewatered sewage sludge is hauled to the Frederick County Landfill for disposal.

16. Permit Changes and Bases for Special Conditions: **Appendix D**

17. Material Storage per 9 VAC 25-31-280.B.2: This permit requires that the facility's O&M Manual include information to address the management of wastes, fluids, and pollutants which may be present at the facility, to avoid unauthorized discharge of such materials.

18. Antibacksliding Review per 9 VAC 25-31-220.L: This permit complies with Antibacksliding provisions of the VPDES Permit Regulation.

19. Impaired Use Status Evaluation per 9 VAC 25-31-220.D: Crooked Run in the immediate vicinity of the discharge is listed as impaired for bacteria and aquatic life (DO). A TMDL for the bacteria and aquatic life impairment has not been prepared or approved for the segment. The permit contains a re-opener condition that may allow the permit limits to be modified, in compliance with section 303(d)(4) of the Act once a TMDL is approved.

20. Regulation of Users per 9 VAC 25-31-280.B.9: N/A – This facility is a POTW.

Introduction

21. Storm Water Management per 9 VAC 25-31-120: Application Required? ☐ Yes ☑ No

    If "No," check one:
    ☑ STPs: This facility does not have a design flow ≥ 1.0 MGD, nor is it required to have an approved POTW pretreatment program under 9 VAC 25-31-10 et seq.
    ☐ Others: This facility's SIC Code(s) and activities do not fall within the categories for which a Storm Water Application submittal is required.

22. Compliance Schedules per 9 VAC 25-31-250: None required by this draft permit.

23. Variances/Alternative Limits or Conditions per 9 VAC 25-31-280.B, 100.J, 100.P, and 100.M.: The permittee has requested waivers from sampling and reporting Fecal Coliform as part of the application. The waiver request has been approved based on the justification provided by the permittee.

24. Financial Assurance Evaluation per 9 VAC 25-650-10: N/A – This facility is owned by a municipality.

    0. Nutrient Trading Regulation per 9 VAC 25-820:
    Watershed General Permit (WGP) Required: ☑ Yes ☐ No
    If Yes: Permit No.: VAN010057
    Date General Permit Effective: January 1, 2007
    This facility is registered for coverage under the GP with two other Frederick-Winchester Service Authority facilities. The Frederick-Winchester Service Authority will address load increases associated with discharges from this facility by upgrading the facility and/or managing the aggregate delivered load discharged from all of the facilities under common ownership or operation in the Potomac-Shenandoah watershed. The aggregate annual waste load allocations (lb/year) for the Frederick-Winchester Service Authority facilities can be found on the latest Registration List maintained on the DEQ web site at:

    http://www.deq.virginia.gov/export/sites/default/vpdes/pdf/9VAC25-820-RegistrationList-Potomac.pdf

26. Threatened and Endangered (T&E) Species Screening per 9 VAC 25-260-20 B.8:
    T&E screening was performed in accordance with the VPDES Memorandum of Understanding. The DGIF (Department of Game and Inland Fisheries) and USFWS (US Fish and Wildlife Service) screening did not indicate the presence of state or federally listed threatened or endangered species or designated Threatened or Endangered Species Waters within the mixing zone or within 2 miles of the discharge location and that are hydrologically connected to the receiving waters. DCR (Department of Conservation and Recreation) noted that the Johns Conservation Site which supports Bigger's cave amphipod is located just east of the discharge location, but that due to the scope of the activity and the distance to the resources, they did not anticipate that the project will adversely impact the natural heritage resouces. DCR also noted that the activity will not affect any documented state-listed plant and insect species.

27. Virginia Environmental Excellence Program (VEEP) Evaluation per § 10.1-1187.1-7:
    Is this facility considered by DEQ to be a participant in the Virginia Environmental Excellence Program in good standing at either the Exemplary Environmental Enterprise (E3) level or the Extraordinary Environmental Enterprise (E4) level?
    ☐ Yes ☑ No

Introduction

28. Public Notice Information per 9 VAC 25-31-290: All pertinent information is on file, and may be inspected and copied by contacting Jason Dameron at: DEQ-Valley Regional Office, P.O. Box 3000, Harrisonburg, Virginia 22801, Telephone No. (540) 574-7824, jrdameron@deq.virginia.gov.

    Persons may comment in writing or by email to the DEQ on the proposed permit action, and may request a public hearing, during the comment period. Comments shall include the name, address, and telephone number of the writer, and shall contain a complete, concise statement of the factual basis for comments. Only those comments received within this period will be considered. The DEQ may decide to hold a public hearing if public response is significant. Requests for public hearings shall state the reason why a hearing is requested, the nature of the issues proposed to be raised in the public hearing and a brief explanation of how the requester's interests would be directly and adversely affected by the proposed permit action. Following the comment period, the Board will make a determination regarding the proposed permit action. This determination will become effective, unless the DEQ grants a public hearing. Due notice of any public hearing will be given.

29. Historical Record:

Original Permit Issuance:	December 14, 1988
Design Flow at Issuance:	0.25 MGD
P&S Approval/ CTC:	November 6, 2001
CTO Issuance:	August 14, 2008
Commencement of Discharge:	July 2007

Introduction

APPENDIX A

DESCRIPTION OF TREATMENT WORKS TREATING DOMESTIC SEWAGE

Outfall 001

Operations Contributing Wastewater:

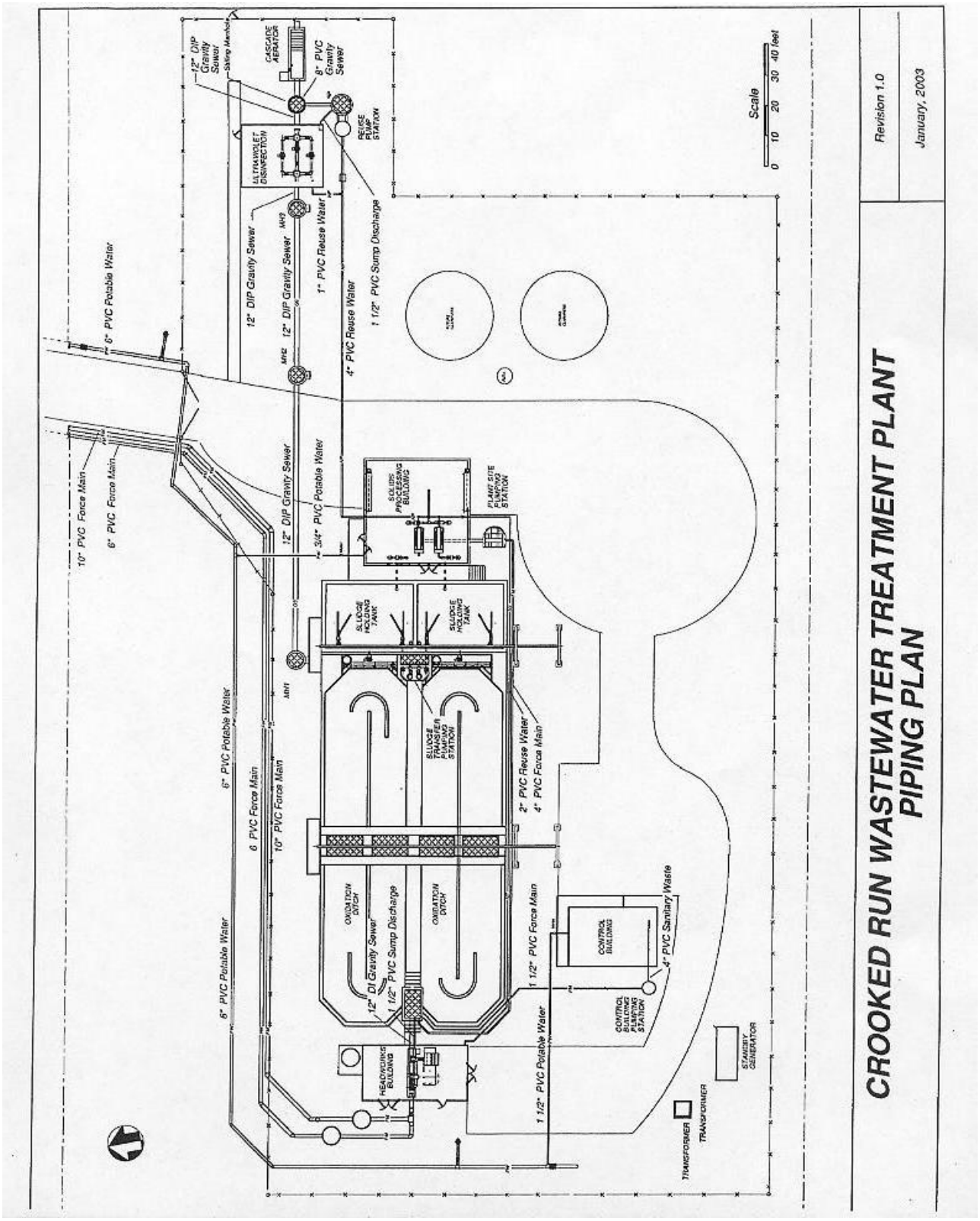
The discharge results from the operation of a wastewater treatment plant serving an age-restricted community.

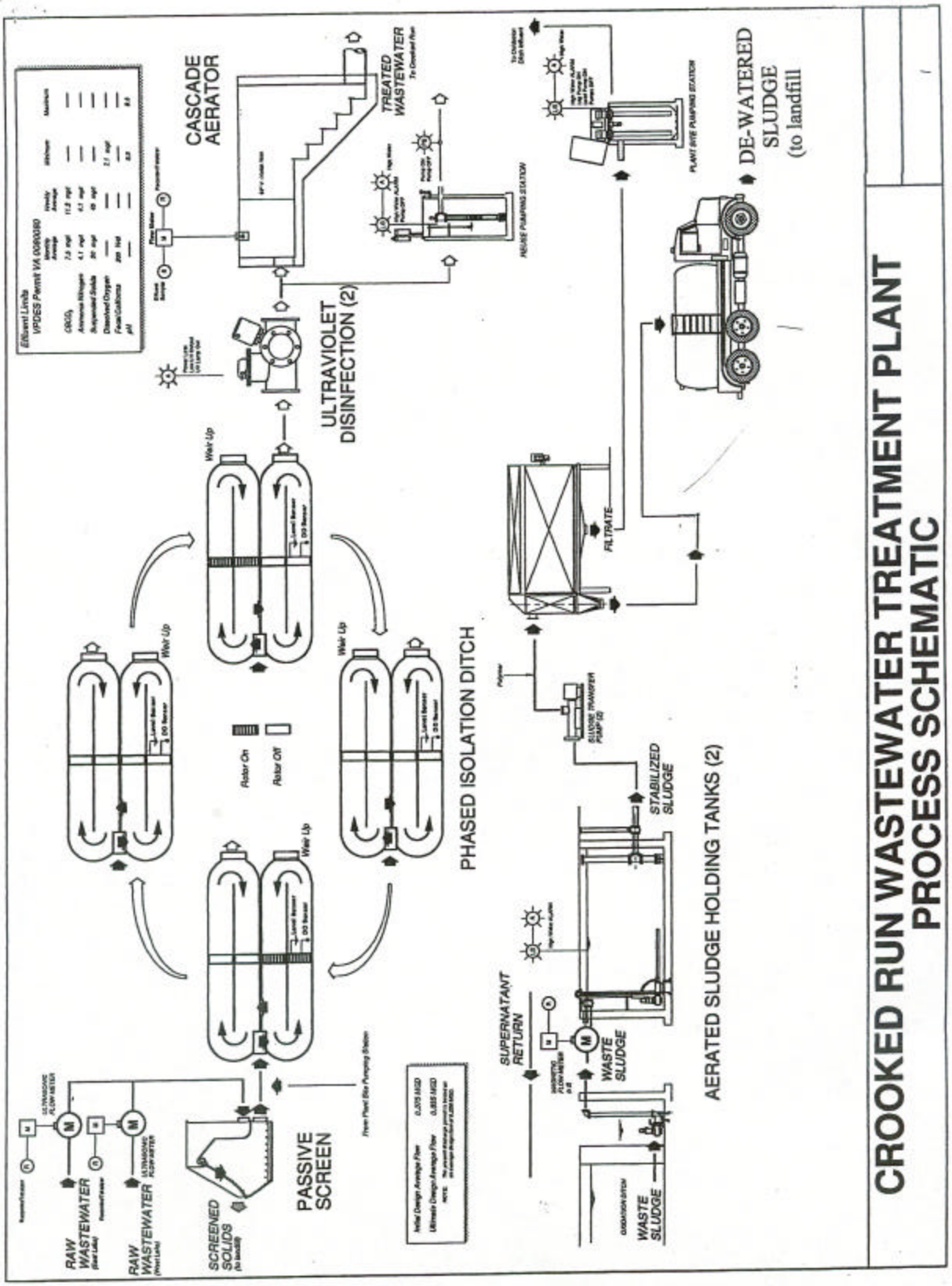
Treatment Works Description (Unit by unit):

See Flow Schematic from the O&M Manual that follows.

Flow:
Design Average Flow = 0.25 MGD
Additional Flow Tiers = 0.375 MGD, 0.625 MGD
Monthly average flow (July 2007 – February 2009) = 0.007 MGD

Flow Schematic




CROOKED RUN WASTEWATER TREATMENT PLANT
PROCESS SCHEMATIC
CASCADE AERATOR
TREATED WASTEWATER
ULTRAVIOLET DISINFECTION (2)
DE-WATERED SLUDGE (to landfill)
PLANT SITE PUMPING STATION
RAW WASTEWATER
RAW WASTEWATER
SCREENED SOLIDS
PASSIVE SCREEN
PHASED ISOLATION DITCH
Rotor On
Rotor Off
Weir Up
FILTRATE
SUPERNATANT RETURN
WASTE SLUDGE
STABILIZED SLUDGE
AERATED SLUDGE HOLDING TANKS (2)
WASTE SLUDGE

APPENDIX B

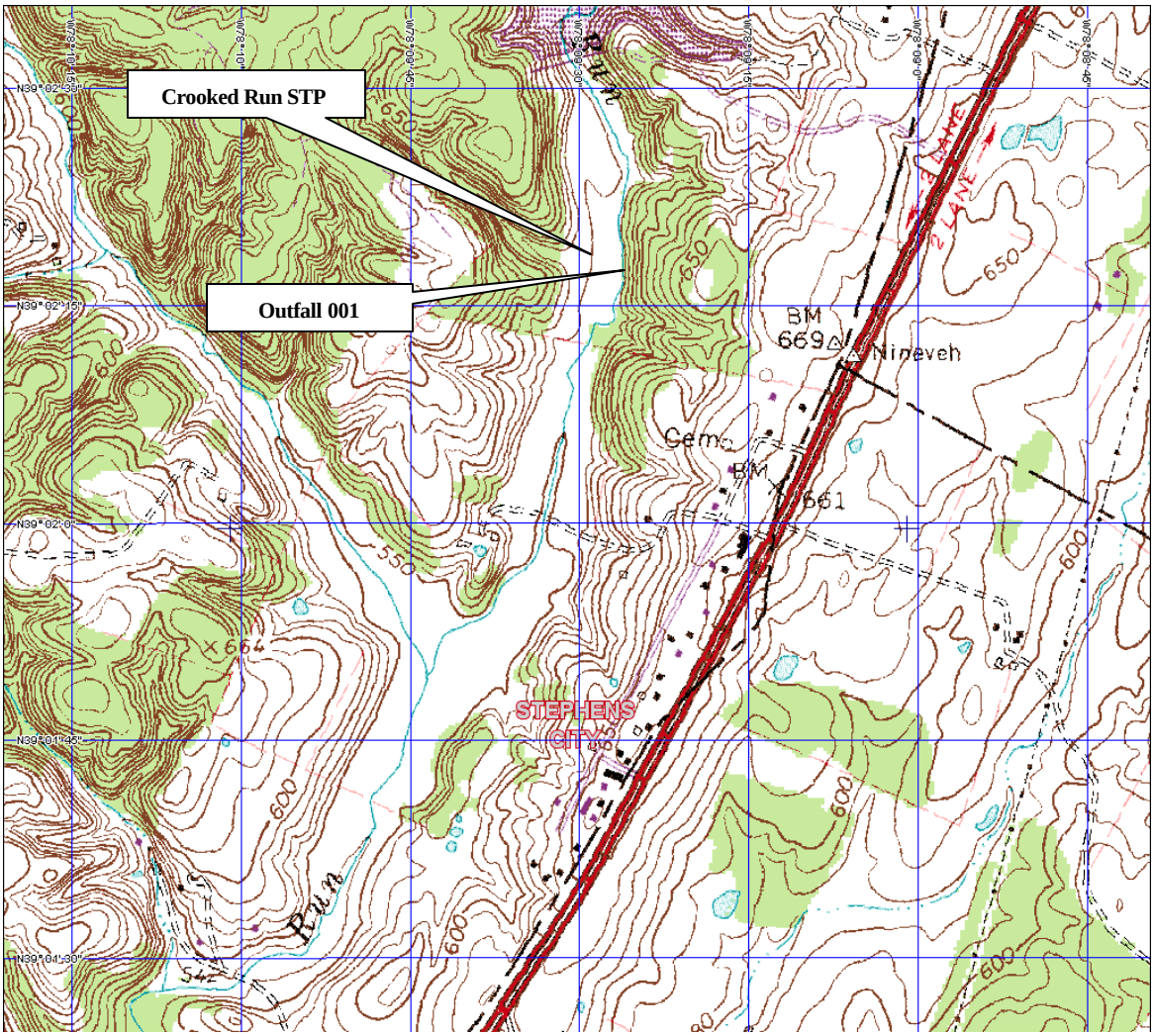
DISCHARGE LOCATION DESCRIPTION AND RECEIVING WATERS INFORMATION

This facility discharges to Crooked Run in Frederick County. The locations of the STP and Outfall 001 are shown on the topographic map below.

Relevant points of interest within the watershed and in the vicinity of the discharge are shown on the enclosed Water Quality Assessment TMDL Review and corresponding map.

Critical flows in the receiving stream at the discharge point are described in a Flow Frequency Determination that is presented on page 4 of this appendix.

Because at critical flow conditions the stream consists solely of effluent, a mixing zone analysis was not performed and complete mix conditions were assumed.



WATER QUALITY ASSESSMENTS TMDL REVIEW - POTOMAC-SHENANDOAH RIVER BASIN (2/20/2009)

IMPAIRED SEGMENT:

SEGMENT ID:	STREAM:	SEGMENT START:	SEGMENT END:	SEGMENT LENGTH:	PARAMETER:
B55R-02-BAC	Borden Marsh Run	9.46	0.00	9.46	E-coli
B55R-03-BAC	Willow Brook	3.95	0.00	3.95	E-coli
B56R-01-BAC	Crooked Run	8.87	0.00	8.87	Fecal Coliform, E-coli
B56R-01-DO	Crooked Run	8.87	0.00	8.87	Dissolved Oxygen
B56R-02-DO	Stephens Run	0.95	0.00	0.95	Dissolved Oxygen
B56R-03-DO	Crooked Run, UT	0.09	0.00	0.09	Dissolved Oxygen

PERMITS:

PERMIT:	FACILITY:	STREAM:	RIVER MILE	LAT	LONG	WBID
VA0080080	**Crooked Run STP**	**Crooked Run**	**8.96**	**390220**	**780928**	**VAV-B56R**
VA0023370	Field Unit 7 STP	Crooked Run, UT	3.26	390303	780820	VAV-B56R
VA0061964	Forest Lake Estates STP	Crooked Run, UT	2.40	390331	781045	VAV-B56R
VA0086100	Bierer STP	Crooked Run	3.36	385909	781103	VAV-B56R
VA0088811	Sandy's Mobile Court STP	Crooked Run, UT	1.38	390335	780903	VAV-B56R
VA0089095	Pioneer Trailer Park STP	Crooked Run, UT	3.13	390414	781103	VAV-B56R
VA0090247	Jackson's Chase	Molly Camel Run, UT	0.27	385504	0781315	VAV-B56R

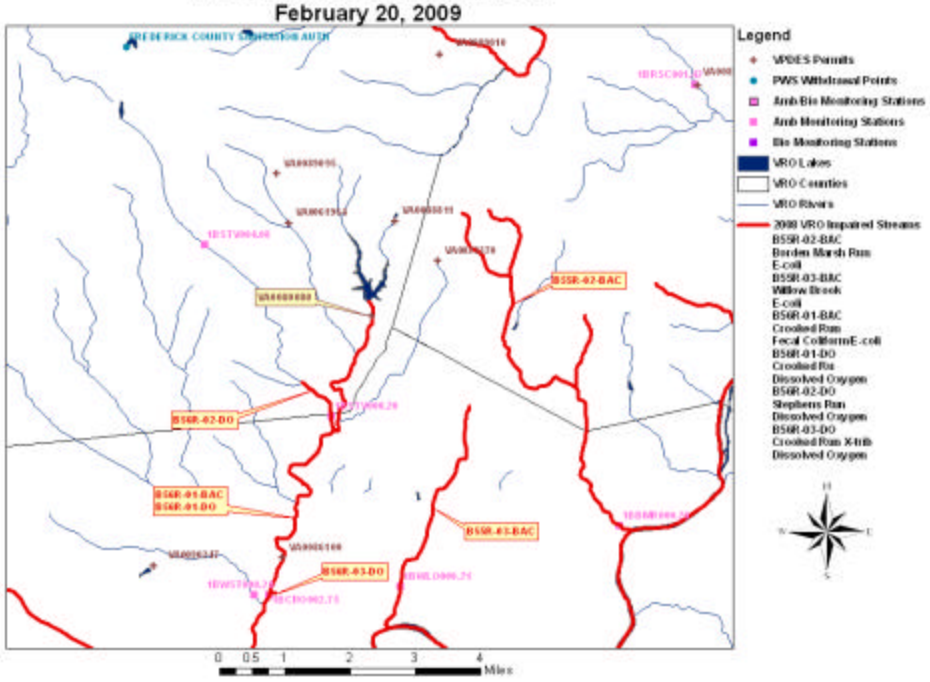
MONITORING STATIONS :

STREAM:	NAME:	RIVER MILE:	RECORD;	LAT;	LONG;
Stephens Run	1BSTV004.08	4.08	7/01/93	380319	0781218
Crooked Run	1BCRO002.75	2.75	9/23/99	385840	0781116
West Run	1BWST000.20	0.2	7/2001	385840	0781131
Stephens Run	1BSTV000.20	0.2	7/28/03	390102	0781010
Willow Brook	1BWLO000.71	0.71	8/9/04	385846	0780901

PUBLIC WATER SUPPLY INTAKES: None

OWNER:	STREAM:	RIVER MILE:

Crooked Run STP-TMDL Information
Potomac-Shenandoah River Basin
February 20, 2009



MEMORANDUM
DEPARTMENT OF ENVIRONMENTAL QUALITY
VALLEY REGIONAL OFFICE

4411 Early Road – P.O. Box 3000 Harrisonburg, VA 22801

SUBJECT: Flow Frequency Determination
Crooked Run STP – VPDES Permit No. VA0080080, Frederick County

TO: Permit Processing File

FROM: Jason Dameron

DATE: March 4, 2009

This memo supersedes Larry Hough's flow frequency determination dated August 19, 2003. The subject facility discharges to Crooked Run near Ninevah, VA. Stream flow frequencies are required at this site for use by the permit writer in developing effluent limitations for the VPDES permit reissuance.

DEQ staff has made several observations and measurements of the flow in streams in the Crooked Run watershed in previous years. In many cases, the stream flows were observed on the same day, at different locations within the watershed. During these observations flow has been evident at upstream locations, but was found to be dry or contained only pooled, stagnant water at downstream locations. This phenomenon is due to the geology/hydrogeology of the watershed, resultin g in both a gaining and a losing stream. For this reason, flow frequencies have been determined to be 0.0 cfs for Crooked Run.

APPENDIX C

EFFLUENT SCREENING AND EFFLUENT LIMITATIONS

Effluent Limitations

A comparison of technology and water quality-based limits was performed, and the most stringent limits were selected. The selected limits are summarized in the table below.

Outfall 001 **Final Limits** **Design Flow: 0.25 MGD**

PARAMETER	BASIS FOR LIMITS	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
		Monthly Avg.		Maximum		Frequency	Sample Type
Flow (MGD)	1	NL		NL		Continuous	TIRE
---	---	Monthly Avg.		Weekly Avg.		---	---
$CBOD_5$	3,4	8 mg/L	8 kg/d	12 mg/L	11 kg/d	3 Days/Week	8 HC
TSS	2	30 mg/L	28 kg/d	45 mg/L	43 kg/d	1/Month	8 HC
Ammonia-N	3	1.6 mg/L		2.2 mg/L		3 Days/Week	8 HC
Effluent Chlorine (TRC)*	3	0.0080 mg/L		0.0098 mg/L		1/Day	Grab
E. coli** (geometric mean)	3	126 N/100 mL		NA		1/Week 10 a.m. to 4 p.m.	Grab
Total Nitrogen	5	5.0 mg/L		NA		1/Month	Calculated***
Total Kjeldahl Nitrogen (as N)	5	NL		NA		1/Month	8 HC
Nitrate plus Nitrite (as N)	5	NL		NA		1/Month	8 HC
Total Phosphorus	5	NL		NA		1/Month	8 HC
---	---	Minimum		Maximum		---	---
pH	3	6.5 S.U.		9.5 S.U.		1/Day	Grab
DO	3,4	7.1 mg/L		NA		1/Day	Grab
Contact Chlorine (TRC)*	3,5	1.0 mg/L		NA		3/Day at 4 hr intervals	Grab

NL = No Limitation, monitoring required
NA = Not Applicable
TIRE = Totalizing, Indicating, and Recording equipment
8 HC = 8 Hour composite sample

* = Applicable only when chlorination is used for disinfection
** = Applicable if an alternative to chlorination is used for disinfection.
*** = Total Nitrogen, which is the sum of TKN and Nitrate plus Nitrite, shall be derived from the results of those tests.

Bases for Effluent Limitations
1. VPDES Permit Regulation (9 VAC 25-31)
2. Federal Effluent Requirements (Secondary Treatment Regulation - 40CFR133)
3. Water Quality Standards (9 VAC 25-260)
4. Regional Stream Model simulation (v 4.11)
5. Best Professional Judgment (BPJ)

Outfall 001 **Final Limits** **Design Flow: 0.375 MGD**

PARAMETER	BASIS FOR LIMITS	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
		Monthly Avg.		Maximum		Frequency	Sample Type
Flow (MGD)	1	NL		NL		Continuous	TIRE
---	---	Monthly Avg.		Weekly Avg.		---	---
$CBOD_5$	3,4	8 mg/L	10 kg/d	12 mg/L	17 kg/d	3 Days/Week	8 HC
TSS	2	30 mg/L	42 kg/d	45 mg/L	64 kg/d	1/Month	8 HC
Ammonia-N	3	1.6 mg/L		2.2 mg/L		3 Days/Week	8 HC
Effluent Chlorine (TRC)*	3	0.0080 mg/L		0.0098 mg/L		1/Day	Grab
E. coli** (geometric mean)	3	126 N/100 mL		NA		1/Week 10 a.m. to 4 p.m.	Grab
Total Nitrogen	5	5 mg/L		NA		2/Month	Calculated***
Total Kjeldahl Nitrogen (as N)	5,6	NL		NA		2/Month	8 HC
Nitrate plus Nitrite (as N)	5,6	NL		NA		2/Month	8 HC
Total Phosphorus	5,6	NL		NA		2/Month	8 HC
Orthophosphate	6	NL		NA		2/Month	8 HC
Total Phosphorus	6	NL		NA		2/Month	8 HC
---	---	Yearly Average		Maximum		---	---
TP – Year to Date	6	NL (mg/L)		NA		1/Month	Calculated
TP – Calendar Year	6	1.5 mg/L		NA		1/Year	Calculated
TN – Year to Date	6	NL (mg/L)		NA		1/Month	Calculated
TN – Calendar Year	6	3.0 mg/L		NA		1/Year	Calculated
---	---	Minimum		Maximum		---	---
pH	3	6.5 S.U.		9.5 S.U.		1/Day	Grab
DO	3,4	6.0 mg/L		NA		1/Day	Grab
Contact Chlorine (TRC)*	3,5	1.0 mg/L		NA		3/Day at 4 hr intervals	Grab

NL = No Limitation, monitoring required NA = Not Applicable 8 HC = 8 Hour composite sample
TIRE = Totalizing, Indicating, and Recording equipment 2/Month = 2 samples per calendar month, no less than 7 days apart
* = Applicable only when chlorination is used for disinfection
** = Applicable if an alternative to chlorination is used for disinfection.
*** = Total Nitrogen, which is the sum of TKN and Nitrate plus Nitrite, shall be derived from the results of those tests.

Bases for Effluent Limitations

1. VPDES Permit Regulation (9 VAC 25-31.)
2. Federal Effluent Requirements (Secondary Treatment Regulation - 40CFR133)
3. Water Quality Standards (9 VAC 25-260)
4. Regional Stream Model simulation (v 4.11)
5. Best Professional Judgment (BPJ)
6. General VPDES Watershed Permit Regulation for Total Nitrogen and Total Phosphorus Discharges and Nutrient Trading in the Chesapeake Watershed in Virginia, 9 VAC 25-820-10 et seq.

Outfall 001 **Final Limits** **Design Flow: 0.625 MGD**

PARAMETER	BASIS FOR LIMITS	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
		Monthly Avg.		Maximum		Frequency	Sample Type
Flow (MGD)	1	NL		NL		Continuous	TIRE
---	---	Monthly Avg.		Weekly Avg.		---	---
$CBOD_5$	3,4	7 mg/L	20 kg/d	10 mg/L	24 kg/d	3 Days/Week	8 HC
TSS	2	30 mg/L	71 kg/d	45 mg/L	110 kg/d	1/Month	8 HC
Ammonia-N	3	1.6 mg/L		2.2 mg/L		3 Days/Week	8 HC
Effluent Chlorine (TRC)*	3	0.0080 mg/L		0.0098 mg/L		1/Day	Grab
E. coli** (geometric mean)	3	126 N/100 mL		NA		1/Week 10 a.m. to 4 p.m.	Grab
Total Nitrogen	5	5 mg/L		NA		2/Month	Calculated***
Total Kjeldahl Nitrogen (as N)	5,6	NL		NA		2/Month	8 HC
Nitrate plus Nitrite (as N)	5,6	NL		NA		2/Month	8 HC
Total Phosphorus	5,6	NL		NA		2/Month	8 HC
Orthophosphate	6	NL		NA		2/Month	8 HC
Total Phosphorus	6	NL		NA		2/Month	8 HC
---	---	Yearly Average		Maximum		---	---
TP – Year to Date	6	NL (mg/L)		NA		1/Month	Calculated
TP – Calendar Year	6	1.0 mg/L		NA		1/Year	Calculated
TN – Year to Date	6	NL (mg/L)		NA		1/Month	Calculated
TN – Calendar Year	6	3.0 mg/L		NA		1/Year	Calculated
---	---	Minimum		Maximum		---	---
pH	3	6.5 S.U.		9.5 S.U.		1/Day	Grab
DO	3,4	6.0 mg/L		NA		1/Day	Grab
Contact Chlorine (TRC)*	3,5	1.0 mg/L		NA		3/Day at 4 hr. intervals	Grab

NL = No Limitation, monitoring required NA = Not Applicable 8 HC = 8 Hour composite sample
TIRE = Totalizing, Indicating, and Recording equipment 2/Month = 2 samples per calendar month, no less than 7 days apart
* = Applicable only when chlorination is used for disinfection
** = Applicable if an alternative to chlorination is used for disinfection.
*** = Total Nitrogen, which is the sum of TKN and Nitrate plus Nitrite, shall be derived from the results of those tests.

Bases for Effluent Limitations

1. VPDES Permit Regulation (9 VAC 25-31.)
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3. Water Quality Standards (9 VAC 25-260)
4. Regional Stream Model simulation (v 4.11)
5. Best Professional Judgment (BPJ)
6. General VPDES Watershed Permit Regulation for Total Nitrogen and Total Phosphorus Discharges and Nutrient Trading in the Chesapeake Watershed in Virginia, 9 VAC 25-820-10 et seq.

Limiting Factors – Overview:

The following potential limiting factors have been considered in developing this permit and fact sheet:

Water Quality Management Plan Regulation (9 VAC 25-720-60 James River Basin)	
A. TMDL limits	**None**
B. Non-TMDL WLAs	**None**
C. CBP (TN & TP) WLAs	**TN, TP by coverage under VAN010057**
Federal Effluent Guidelines	**$CBOD_5$, TSS, pH**
BPJ/Agency Guidance limits	**TRC (contact)**
Water Quality-based Limits - numeric	**$CBOD_5$, DO, Ammonia-N, TRC (effluent), E. coli, pH**
Water Quality-based Limits - narrative	**None**
Toxics Management Plan (TMP)	**None**
Storm Water Limits	**Not applicable**

The permittee has indicated that the discharge is intermittent; however, because the facility discharges daily, and is expected to have a continuous discharge as flows approach the facility's design capacity, as a conservative approach the discharge has been considered to be continuous when establishing permit limits.

EVALUATION OF THE EFFLUENT – CONVENTIONAL POLLUTANTS

The 0.25 MGD flow tier was previously modeled using the Regional Stream Model (v.3.2). Due to the need to model the 0.375 MGD and 0.625 MGD flow tiers, the 0.25 MGD flow tier was also remodeled using the Regional Stream Model (v.4.11). The model demonstrated that the limits in the previous permit (shown below) for the 0.25 MGD flow tier were still protective. The limits demonstrated to be protective for the 0.375 MGD and 0.625 MGD are also shown below. The modeling information has been included at the end of this appendix.

0.25 MGD	0.375 MGD	0.625 MGD
$CBOD_5$ = 8 mg/L	$CBOD_5$ = 8 mg/L	$CBOD_5$ = 7 mg/L
TKN = 5 mg/L	TKN = 5 mg/L	TKN = 5 mg/L
DO = 7.1 mg/L	DO = 6.0 mg/L	DO = 6.0 mg/L

Although the model indicates the need for TKN limits, the Ammonia-N and TN limits in the permit are stringent enough to adequately limit TKN in the discharge; therefore, TKN limits have not been included in the permit.

The TSS limits are consistent with the Secondary Treatment Regulation and have been carried forward from the previous permit for the 0.25 MGD flow tier.

The pH limits reflect the current Water Quality Standard for pH in the receiving stream and have been carried forward from the previous permit for the 0.25 MGD flow tier.

EVALUATION OF THE EFFLUENT – DISINFECTION

The E. coli limits have been carried forward from the previous permit. These limits reflect the current Water Quality Standard for E. coli in the receiving stream. Chlorine limits are also specified in the permit, but are only applicable should the facility need to utilize chlorine disinfection.

EVALUATION OF THE EFFLUENT – NUTRIENTS

Following the public hearing for the reissuance of the previous permit, several comments were received regarding caves and sinkholes found in close proximity to the receiving stream. As a follow-up, a cave investigation was performed, and the permittee's geotechnical consultant concluded that the potential for surface water from the stream to intermingle with groundwater during periods of low flow was higher than first determined.

Based on these findings, a monthly average TN limit of 5.0 mg/L was included in the previous permit to provide a high level of assurance that groundwater would not be impacted, and to be consistent with recommendations considered for those facilities determined to be "significant dischargers" by the Agency's Chesapeake Bay Program. Because the TN limit was included in the permit, TKN and Nitrate plus Nitrite monitoring was also required in order to calculate TN. Monitoring for TP was also included in the previous permit based on concerns received regarding the discharge of nutrients from this facility.

The monthly average TN limit and the monthly monitoring requirements for TP, TN, TKN, and Nitrate plus Nitrite have been carried forward from the previous permit for the 0.25 MGD flow tier. The monthly average TN limit has also been imposed for the 0.375 MGD and 0.625 MGD flow tiers with the frequency of monitoring for all nutrient parameters set at 2/Month to match the frequency required for monitoring compliance with the annual average concentration limits.

In accordance with § 62.1-44.19:14.C.5. of the Code of Virginia, this Significant Discharger has submitted a Registration Statement and DEQ has recognized that they are covered under the General Virginia Pollutant Discharge Elimination System (VPDES) Watershed Permit Regulation for Total Nitrogen and Total Phosphorus Discharges and Nutrient Trading in the Chesapeake Bay Watershed in Virginia (9 VAC 25-820-10 *et seq.*). The effective date of coverage is January 1, 2007. Coverage under the General Permit will expire December 31, 2011.

The Frederick-Winchester Service Authority has indicated that Crooked Run STP will be "bubbled" with their other facilities. From an aggregate standpoint, Frederick-Winchester Service Authority has indicated that a TN limit of 3.0 mg/L and TP limits of 1.5 mg/L and 1.0 mg/L, for the 0.375 and 0.625 MGD expansion flow tiers respectively will maintain the aggregate WLAs for TN and TP; therefore, offset language has not been included in the permit.

EVALUATION OF THE EFFLUENT – TOXIC POLLUTANTS

Input parameters for instream water quality criteria (WQC) and waste load allocations (WLA)

Stream: Water quality data for the receiving stream was obtained from Ambient Monitoring Station No. 1BCRO002.75 on Crooked Run at the Rte 627 bridge. Toxic substances, including Ammonia-N and TRC, are assumed absent in the receiving stream because there are no data to indicate their presence.

Stream Parameter	Value	Units
Mean Hardness (as $CaCO_3$) =	222	mg/L
90^{th} Percentile Temperature (Annual) =	21	°C
90^{th} Percentile Temperature (Wet season*) =	15	°C
90^{th} Percentile Maximum pH =	8.1	SU
10^{th} Percentile Maximum pH =	7.1	SU

Effluent: The pH and temperature values were obtained from the daily operational data submitted by the permittee. The hardness value was assumed to be equal to the receiving stream value since no data was available.

Effluent Parameter	Value	Units
Mean Hardness (as $CaCO_3$) =	222	mg/L
90th Percentile Temperature (Annual) =	26	°C
90th Percentile Temperature (Wet season*) =	19	°C
90th Percentile Maximum pH =	7.8	SU
10th Percentile Maximum pH =	7.2	SU

* Wet Season = December through April

Water Quality Criteria (WQC) and Waste Load Allocations (WLAs) were calculated for the WQS parameters for which data is available. Since Crooked Run was determined to have a flow of 0.0 cfs under critical flow conditions, the WQC and WLAs are the same for all flow tiers; therefore, only the WQC and WLAs for the 0.625 MGD flow tier are presented in this appendix. Current agency guidelines recommends the evaluation of toxic pollutant limits for TRC and Ammonia-N based on default effluent concentrations of 20 mg/L and 9 mg/L, respectively. The effluent data were analyzed per the protocol for evaluation of effluent toxic pollutants included in this appendix with the following results:

? TRC: Limits identical to those in the previous permit for the 0.25 MGD flow tier were determined to be necessary. Limits were determined to be necessary for the 0.375 MGD and 0.625 MGD flow tiers.

? Ammonia-N: More stringent limits were determined to be necessary for the 0.25 MGD flow tier. A schedule of compliance has not been included in the permit because a review of effluent monitoring data submitted by the permittee indicates that the more stringent limits can consistently be met. Limits were determined to be necessary for the 0.375 MGD and 0.625 MGD flow tiers.

- Additional monitoring data is needed for a number of pollutants due to the lack of effluent quality data. The permittee must monitor the effluent at Outfall 001 for the substances noted in Attachment A of the permit within one year of the permit's effective date for the 0.25 MGD flow tier and within one year following the issuance of the CTOs for the 0.375 MGD and 0.625 MGD flow tiers.

WATER QUALITY CRITERIA / WASTE LOAD ALLOCATION ANALYSIS

Facility Name: Crooked Run STP
Receiving Stream: Crooked Run
Permit No.: VA0080080
Date: 4/28/2009
Version: OWP Guidance Memo 00-2011 (8/24/00)

Stream Information			Stream Flows			Mixing Information			Effluent Information		
Mean Hardness (as CaCO3) =	222	mg/L	1Q10 (Annual) =	0	MGD	Annual - 1Q10 Flow =	100	%	Mean Hardness (as CaCO3) =	222	mg/L
90% Temperature (Annual) =	21	deg C	7Q10 (Annual) =	0	MGD	- 7Q10 Flow =	100	%	90% Temp (Annual) =	26	deg C
90% Temperature (Wet season) =	15	deg C	30Q10 (Annual) =	0	MGD	- 30Q10 Flow =	100	%	90% Temp (Wet season) =	19	deg C
90% Maximum pH =	8.1	SU	1Q10 (Wet season) =	0	MGD	Wet Season - 1Q10 Flow =	100	%	90% Maximum pH =	7.8	SU
10% Maximum pH =	7.1	SU	30Q10 (Wet season) =	0	MGD	- 30Q10 Flow =	100	%	10% Maximum pH =	7.2	SU
Tier Designation =	1		30Q5 =	0	MGD				Current Discharge Flow =	0.25	MGD
Public Water Supply (PWS) Y/N? =	N		Harmonic Mean =	0	MGD				Discharge Flow for Limit Analysis =	0.625	MGD
V(alley) or P(iedmont)? =	V		Annual Average =	0	MGD						
Trout Present Y/N? =	N										
Early Life Stages Present Y/N? =	Y										

Footnotes:

1. All concentrations expressed as micrograms/liter (ug/l), unless noted otherwise.
2. All flow values are expressed as Million Gallons per Day (MGD).
3. Discharge volumes are highest monthly average or 2C maximum for Industries and design flows for Municipals.
4. Hardness expressed as mg/l CaCO3. Standards calculated using Hardness values in the range of 25-400 mg/l CaCO3.
5. "Public Water Supply" protects for fish & water consumption. "Other Surface Waters" protects for fish consumption only.
6. Carcinogen "Y" indicates carcinogenic parameter.
7. Ammonia WQSs selected from separate tables, based on pH and temperature.
8. Metals measured as Dissolved, unless specified otherwise.
9. WLA = Waste Load Allocation (based on standards).
10. WLA = Waste Load Allocation (based on standards).
11. WLAs are based on mass balances (less background, if data exist).
12. Acute - 1 hour avg. concentration not to be exceeded more than 1/3 years.
13. Chronic - 4 day avg. concentration (30 day avg. for Ammonia) not to be exceeded more than 1/3 years.
14. Mass balances employ 1Q10 for Acute, 30Q10 for Chronic Ammonia, 7Q10 for Other Chronic, 30Q5 for Non-carcinogens, Harmonic Mean for Carcinogens, and Annual Average for Dioxin. Actual flows employed are a function of the mixing analysis and may be less than the actual critical flows.
15. Effluent Limitations are calculated elsewhere using the minimum WLA and EPA's statistical approach (Technical Support Document).

Facility Name:	Permit No.:	POST - EXPANSION WATER QUALITY CRITERIA 0.625 MGD Discharge Flow - Mix per "Mixer"				NON-ANTIDEGRADATION WASTE LOAD ALLOCATIONS 0.625 MGD Discharge - Mix per "Mixer"		
Crooked Run STP	VA0080080			Human Health				
Receiving Stream:	Date:	Aquatic Protection		Public Water	Other Surface	Aquatic Protection		Human
Crooked Run	4/28/2009							
Toxic Parameter and Form	Carcinogen?	Acute	Chronic	Supplies	Waters	Acute	Chronic	Health
Ammonia-N (Annual)	N	1.2E+01 mg/L	1.5E+00 mg/L	None	None	1.2E+01 mg/L	1.5E+00 mg/L	N/A
Chlorine, Total Residual	N	1.9E-02 mg/L	1.1E-02 mg/L	None	None	1.9E-02 mg/L	1.1E-02 mg/L	N/A

PROTOCOL FOR THE EVALUATION OF THE EFFLUENT – TOXIC POLLUTANTS

Toxic pollutants were evaluated in accordance with OWP Guidance Memo No. 00-2011 (8/24/00). Acute and Chronic Waste Load Allocations (WLA_a and WLA_c) were analyzed according to the protocol below using a statistical approach (STAT.exe) to determine the necessity and magnitude of limits. Human Health Waste Load Allocations (WLA_{hh}) were analyzed according to the same protocol through a simple comparison with the effluent data. If the WLA_{hh} exceeded the effluent datum or data mean, no limits were required. If the effluent datum or data mean exceeded the WLA_{hh}, the WLA_{hh} was imposed as the limit.

Since the discharge is to an intermittent stream, all upstream (background) pollutant concentrations are assumed to be "0".

The steps used in evaluating the effluent data are as follows:

A. If all data are reported as "below detection" or < the required Quantification Level (QL), and at least one detection level is = the required QL, then the pollutant is considered to be not significantly present in the discharge and no further monitoring is required.

B. If all data are reported as "below detection", and all detection levels are > the required QL, then an evaluation is performed in which the pollutant is assumed present at the lowest reported detection level.

B.1. If the evaluation indicates that no limits are needed, then the existing data set is adequate and no further monitoring is required.

B.2. If the evaluation indicates that limits are needed, then the existing data set is inadequate to make a determination and additional monitoring is required.

C. If any data value is reported as detectable at or above the required QL, then the data are adequate to determine whether effluent limits are needed.

C.1. If the evaluation indicates that no limits are needed, then no further monitoring is required.

C.2. If the evaluation indicates that limits are needed, then the limits and associated requirements are specified in the draft permit.

C.3. (Exception for Metals data only) If the evaluation indicates that limits are needed, but the data are reported as a form other than "Dissolved", then the existing data set is inadequate to make a determination and additional monitoring is required.

Parameter	CASRN	Type	QL (µg/L)	Data (µg/L unless noted otherwise)	Source of Data	Data Eval
Acenapthene	83-32-9	B	10	No data. Monitoring required in the permit.	---	---
Acrolein	107-02-8	V	---	No data. Monitoring required in the permit.	---	---
Acrylonitrile[C]	107-13-1	V	---	No data. Monitoring required in the permit.	---	---
Aldrin [C]	309-00-2	P	0.05	No data. Monitoring required in the permit.	---	---
Ammonia-N (mg/L)	766-41-7	X	0.2 mg/L	**Default = 9 mg/L**	a	C.2
Anthracene	120-12-7	B	10	No data. Monitoring required in the permit.	---	---
Antimony	7440-36-0	M	0.2	No data. Monitoring required in the permit.	---	---
Arsenic	7440-38-2	M	1.0	No data. Monitoring required in the permit.	---	---
Barium	7440-39-3	M	---	Applicable to PWS waters only	---	---
Benzene [C]	71-43-2	V	10	No data. Monitoring required in the permit.	---	---
Benzidine [C]	92-87-5	B	---	No data. Monitoring required in the permit.	---	---
Benzo (a) anthracene [C]	56-55-3	B	10	No data. Monitoring required in the permit.	---	---
Benzo (b) fluoranthene [C]	205-99-2	B	10	No data. Monitoring required in the permit.	---	---
Benzo (k) fluoranthene [C]	207-08-9	B	10	No data. Monitoring required in the permit.	---	---
Benzo (a) pyrene [C]	50-32-8	B	10	No data. Monitoring required in the permit.	---	---
Bis2-Chloroethyl Ether	111-44-4	B	---	No data. Monitoring required in the permit.	---	---
Bis2-Chloroisopropyl Ether	39638-32-9	B	---	No data. Monitoring required in the permit.	---	---
Bromoform [C]	75-25-2	V	10	No data. Monitoring required in the permit.	---	---
Butylbenzylphthalate	85-68-7	B	10	No data. Monitoring required in the permit.	---	---
Cadmium	7440-43-9	M	0.3	No data. Monitoring required in the permit.	---	---
Carbon Tetrachloride [C]	56-23-5	V	10	No data. Monitoring required in the permit.	---	---
Chlordane [C]	57-74-9	P	0.2	No data. Monitoring required in the permit.	---	---
Chloride (mg/L)	16887-00-6	X	---	No data. Monitoring required in the permit.	---	---
TRC (mg/L)	7782-50-5	X	0.1 mg/L	**Default = 20 mg/L**	a	C.2
Chlorobenzene (synonym = Monochlorobenzene)	108-90-7	V	50	No data. Monitoring required in the permit.	---	---
Chlorodibromomethane[C]	124-48-1	V	10	No data. Monitoring required in the permit.	---	---
Chloroform [C]	67-66-3	V	10	No data. Monitoring required in the permit.	---	---
2-Chloronaphthalene	91-58-7	B	---	No data. Monitoring required in the permit.	---	---
2-Chlorophenol	95-57-8	A	10	No data. Monitoring required in the permit.	---	---
Chlorpyrifos (synonym = Dursban)	2921-88-2	P	---	No data. Monitoring required in the permit.	---	---
Chromium III	16065-83-1	M	0.5	No data. Monitoring required in the permit.	---	---
Chromium VI	18540-29-9	M	0.5	No data. Monitoring required in the permit.	---	---
Chromium, Total	7440-47-3	M	---	Applicable to PWS waters only	---	---
Chrysene [C]	218-01-9	B	10	No data. Monitoring required in the permit.	---	---
Copper	7440-50-8	M	0.5	No data. Monitoring required in the permit.	---	---
Cyanide	57-12-5	X	10	No data. Monitoring required in the permit.	---	---
DDD [C]	72-54-8	P	0.1	No data. Monitoring required in the permit.	---	---
DDE [C]	72-55-9	P	0.1	No data. Monitoring required in the permit.	---	---
DDT [C]	50-29-3	P	0.1	No data. Monitoring required in the permit.	---	---
Demeton	8065-48-3	P	---	No data. Monitoring required in the permit.	---	---
Dibenz(a,h)anthracene [C]	53-70-3	B	20	No data. Monitoring required in the permit.	---	---
Dibutyl phthalate (syn. = Di-n-Butyl Phthalate)	84-74-2	B	10	No data. Monitoring required in the permit.	---	---
Dichloromethane (syn. = Methylene Chloride) [C]	75-09-2	V	20	No data. Monitoring required in the permit.	---	---

Parameter	CASRN	Type	QL (µg/L)	Data (µg/L unless noted otherwise)	Source of Data	Data Eval
1,2-Dichlorobenzene	95-50-1	B	10	No data. Monitoring required in the permit.	---	---
1,3-Dichlorobenzene	541-73-1	B	10	No data. Monitoring required in the permit.	---	---
1,4-Dichlorobenzene	106-46-7	B	10	No data. Monitoring required in the permit.	---	---
3,3-Dichlorobenzidine [C]	91-94-1	B	---	No data. Monitoring required in the permit.	---	---
Dichlorobromomethane [C]	75-27-4	V	10	No data. Monitoring required in the permit.	---	---
1,2-Dichloroethane [C]	107-06-2	V	10	No data. Monitoring required in the permit.	---	---
1,1-Dichloroethylene	75-35-4	V	10	No data. Monitoring required in the permit.	---	---
1,2-trans-dichloroethylene	156-60-5	V	---	No data. Monitoring required in the permit.	---	---
2,4-Dichlorophenol	120-83-2	A	10	No data. Monitoring required in the permit.	---	---
2,4-Dichlorophenoxy acetic acid (syn. = 2,4-D)	94-75-7	P	---	Applicable to PWS waters only	---	---
1,2-Dichloropropane [C]	78-87-5	V	---	No data. Monitoring required in the permit.	---	---
1,3-Dichloropropene	542-75-6	V	---	No data. Monitoring required in the permit.	---	---
Dieldrin [C]	60-57-1	P	---	No data. Monitoring required in the permit.	---	---
Diethyl Phthalate	84-66-2	B	10	No data. Monitoring required in the permit.	---	---
Di-2-Ethylhexyl Phthalate [C]	117-81-7	B	10	No data. Monitoring required in the permit.	---	---
2,4-Dimethylphenol	105-67-9	A	10	No data. Monitoring required in the permit.	---	---
Dimethyl Phthalate	131-11-3	B	---	No data. Monitoring required in the permit.	---	---
2,4 Dinitrophenol	51-28-5	A	---	No data. Monitoring required in the permit.	---	---
2-Methyl-4,6-Dinitrophenol	534-52-1	A	---	No data. Monitoring required in the permit.	---	---
2,4-Dinitrotoluene [C]	121-14-2	B	10	No data. Monitoring required in the permit.	---	---
Dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin) (ppq)	1746-01-6	X	0.00001	Applicable to Paper Mills & Oil Refineries only	---	---
1,2-Diphenylhydrazine [C]	122-66-7	B	---	No data. Monitoring required in the permit.	---	---
Alpha-Endosulfan (I)	959-98-8	P	---	No data. Monitoring required in the permit.	---	---
Beta-Endosulfan (II)	33213-65-9	P	---	No data. Monitoring required in the permit.	---	---
Endosulfan Sulfate	1031-07-8	P	---	No data. Monitoring required in the permit.	---	---
Endrin	72-20-8	P	0.1	No data. Monitoring required in the permit.	---	---
Endrin Aldehyde	7421-93-4	P	---	No data. Monitoring required in the permit.	---	---
Ethylbenzene	100-41-4	V	10	No data. Monitoring required in the permit.	---	---
Fluoranthene	206-44-0	B	10	No data. Monitoring required in the permit.	---	---
Fluorene	86-73-7	B	10	No data. Monitoring required in the permit.	---	---
Foaming Agents		X	---	Applicable to PWS waters only	---	---
Guthion	86-50-0	P	---	No data. Monitoring required in the permit.	---	---
Heptachlor [C]	76-44-8	P	0.05	No data. Monitoring required in the permit.	---	---
Heptachlor Epoxide [C]	1024-57-3	P	---	No data. Monitoring required in the permit.	---	---
Hexachlorobenzene [C]	118-74-1	B	---	No data. Monitoring required in the permit.	---	---
Hexachlorobutadiene [C]	87-68-3	B	---	No data. Monitoring required in the permit.	---	---
Hexachlorocyclohexane Alpha-BHC [C]	319-84-6	P	---	No data. Monitoring required in the permit.	---	---
Hexachlorocyclohexane Beta-BHC [C]	319-85-7	P	---	No data. Monitoring required in the permit.	---	---
Hexachlorocyclohexane Gamma-BHC [C] (syn. = Lindane)	58-89-9	P	---	No data. Monitoring required in the permit.	---	---
Hexachlorocyclopentadiene	77-47-4	B	---	No data. Monitoring required in the permit.	---	---
Hexachloroethane [C]	67-72-1	B	---	No data. Monitoring required in the permit.	---	---
Hydrogen Sulfide	7783-06-4	X	---	No data. Monitoring required in the permit.	---	---
Indeno (1,2,3-cd) pyrene [C]	193-39-5	B	20	No data. Monitoring required in the permit.	---	---

Parameter	CASRN	Type	QL (µg/L)	Data (µg/L unless noted otherwise)	Source of Data	Data Eval
Iron	7439-89-6	M	1.0	Applicable to PWS waters only	---	---
Isophorone[C]	78-59-1	B	10	No data. Monitoring required in the permit.	---	---
Kepone	143-50-0	P	---	No data. Monitoring required in the permit.	---	---
Lead	7439-92-1	M	0.5	No data. Monitoring required in the permit.	---	---
Malathion	121-75-5	P	---	No data. Monitoring required in the permit.	---	---
Manganese	7439-96-5	M	0.2	Applicable to PWS waters only	---	---
Mercury	7439-97-6	M	1.0	No data. Monitoring required in the permit.	---	---
Methyl Bromide	74-83-9	V	---	No data. Monitoring required in the permit.	---	---
Methoxychlor	72-43-5	P	---	No data. Monitoring required in the permit.	---	---
Mirex	2385-85-5	P	---	No data. Monitoring required in the permit.	---	---
Nickel	7440-02-0	M	0.5	No data. Monitoring required in the permit.	---	---
Nitrate (as N)	14797-55-8	X	---	Applicable to PWS waters only	---	---
Nitrobenzene	98-95-3	B	10	No data. Monitoring required in the permit.	---	---
N-Nitrosodimethylamine[C]	62-75-9	B	---	No data. Monitoring required in the permit.	---	---
N-Nitrosodiphenylamine[C]	86-30-6	B	---	No data. Monitoring required in the permit.	---	---
N-Nitrosodi-n-propylamine[C]	621-64-7	B	---	No data. Monitoring required in the permit.	---	---
Parathion	56-38-2	P	---	No data. Monitoring required in the permit.	---	---
PCB-1016	12674-11-2	p	1	No data. Monitoring required in the permit.	---	---
PCB-1221	11104-28-2	p	1	No data. Monitoring required in the permit.	---	---
PCB-1232	11141-16-5	p	1	No data. Monitoring required in the permit.	---	---
PCB-1242	53469-21-9	p	1	No data. Monitoring required in the permit.	---	---
PCB-1248	12672-29-6	p	1	No data. Monitoring required in the permit.	---	---
PCB-1254	11097-69-1	p	1	No data. Monitoring required in the permit.	---	---
PCB-1260	11096-82-5	p	1	No data. Monitoring required in the permit.	---	---
PCB Total[C]	1336-36-3	p	---	No data. Monitoring required in the permit.	---	---
Pentachlorophenol[C]	87-86-5	A	50	No data. Monitoring required in the permit.	---	---
Phenol	108-95-2	A	10	No data. Monitoring required in the permit.	---	---
Pyrene	129-00-0	B	10	No data. Monitoring required in the permit.	---	---
Gross Alpha Particle Activity (pCi/L)		R	---	No data. Monitoring required in the permit.	---	---
Beta Particle & Photon Activity (mrem/yr)		R	---	No data. Monitoring required in the permit.	---	---
Strontium-90 (pCi/L)		R	---	No data. Monitoring required in the permit.	---	---
Tritium (pCi/L)		R	---	No data. Monitoring required in the permit.	---	---
Selenium	7782-49-2	M	2.0	No data. Monitoring required in the permit.	---	---
Silver	7440-22-4	M	0.2	No data. Monitoring required in the permit.	---	---
Sulfate	14808-79-8	X	---	Applicable to PWS waters only	---	---
1,1,2,2-Tetrachloroethane[C]	79-34-5	V	---	No data. Monitoring required in the permit.	---	---
Tetrachloroethylene[C]	127-18-4	V	10	No data. Monitoring required in the permit.	---	---
Thallium	7440-28-0	M	---	No data. Monitoring required in the permit.	---	---
Toluene	10-88-3	V	10	No data. Monitoring required in the permit.	---	---
Total dissolved solids		X	---	Applicable to PWS waters only	---	---
Toxaphene[C]	8001-35-2	P	5.0	No data. Monitoring required in the permit.	---	---
Tributyltin	60-10-5	P	---	No data. Monitoring required in the permit.	---	---
1,2,4-Trichlorobenzene	120-82-1	B	10	No data. Monitoring required in the permit.	---	---

Parameter	CASRN	Type	QL (µg/L)	Data (µg/L unless noted otherwise)	Source of Data	Data Eval
1,1,2-Trichloroethane[C]	79-00-5	V	---	No data. Monitoring required in the permit.	---	---
Trichloroethylene [C]	79-01-6	V	10	No data. Monitoring required in the permit.	---	---
2,4,6-Trichlorophenol [C]	88-06-2	A	10	No data. Monitoring required in the permit.	---	---
2-(2,4,5-Trichlorophenoxy) propionic acid (synonym = Silvex)	93-72-1	P	---	Applicable to PWS waters only	---	---
Vinyl Chloride [C]	75-01-4	V	10	No data. Monitoring required in the permit.	---	---
Zinc	7440-66-6	M	2.0	No data. Monitoring required in the permit.	---	---

"Type" column indicates a category assigned to the referenced substance (see below):
A = Acid Extractable Organic Compounds
B = Base/Neutral Extractable Organic Compounds
M = Metals
p = PCBs
P = Pesticides
V = Volatile Organic Compounds
X = Miscellaneous Compounds and Parameters

The **superscript "C"** following the parameter name indicates that the substance is a known or suspected carcinogen; human health criteria at risk level 10^{-5}.

CASRN = Chemical Abstract Service Registry Number for each parameter is referenced in the current Water Quality Standards. A unique numeric identifier designating only one substance. The Chemical Abstract Service is a division of the American Chemical Society.

"Source of Data" codes:
a = Agency default value

"Data Evaluation" codes:
See section titled "PROTOCOL FOR THE EVALUATION OF EFFLUENT – TOXI POLLUTANTS" (preceding the parameter table) for an explanation of the code used.

STAT.EXE Results

Ammonia-N

Chronic averaging period = 30
WLAa = 12
WLAc = 1.5
Q.L. = 0.2
# samples/mo. = 12
# samples/wk. = 3

Summary of Statistics:
observations = 1
Expected Value = 9
Variance = 29.16
C.V. = 0.6
97th percentile daily values = 21.9007
97th percentile 4 day average = 14.9741
97th percentile 30 day average= 10.8544
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data

A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 3.02650514012447
Average Weekly Limit = 2.21371811752459
Average Monthly Limit = 1.64893065435532

The data are: 9

TRC

Chronic averaging period = 4
WLAa = 0.019
WLAc = 0.011
Q.L. = 0.1
# samples/mo. = 30
# samples/wk. = 7

Summary of Statistics:
observations = 1
Expected Value = 20
Variance = 144
C.V. = 0.6
97th percentile daily values = 48.6683
97th percentile 4 day average = 33.2758
97th percentile 30 day average= 24.1210
< Q.L. = 0
Model used = BPJ Assumptions, type 2 data

A limit is needed based on Chronic Toxicity
Maximum Daily Limit = 1.60883226245855E-02
Average Weekly Limit = 9.8252545713861E-03
Average Monthly Limit = 7.9737131838758E-03

The data are: 20

Instream Monitoring

In response to public concerns expressed during the previous permit reissuance process, instream monitoring for Nitrate-N, Nitrite-N, and TKN was required in the previous permit. Monitoring was required monthly at a point within 200 feet upstream of the Outfall 001 and at a point approximately 0.5 miles downstream of Outfall 001. The facility did not begin discharging until July 2007; however, instream monitoring data (shown below) is available beginning in January 2005. Based on a review of the instream monitoring data obtained both before and after the facility began discharging, it does not appear that the facility is causing instream issues due to the discharge of nitrogen parameters. The requirement of the previous permit has been fulfilled and further instream monitoring has been determined to not be necessary.

	Upstream			**Downstream**		
Date	**TKN (mg/L)**	**Nitrate (mg/L)**	**TN (mg/L)**	**TKN (mg/L)**	**Nitrate (mg/L)**	**TN (mg/L)**
January-05	0.666	0.167	0.843	0.754	0.19	0.954
February-05	0.77	0.17	0.95	0.764	0.154	0.928
March-05	0.914	0.156	1.08	0.66	0.128	0.798
April-05	0.745	0.107	0.862	0.735	0.112	0.857
May-05				0.509	0.1	0.619
July-05				2	0.369	2.379
August-05				1.8	0.101	1.911
September-05				1.41	0.222	1.642
October-05				6.6	0.329	6.939
November-05				2.87	0.411	3.291
December-05				0.557	0.109	0.676
February-06	0.596	0.196	0.802	0.943	0.193	1.146
March-06				0.819	0.1	0.929
April-06				2.53	0.1	2.64
May-06				0.864	0.1	0.974
June-06				1.23	0.1	1.34
August-06				3.81	0.117	3.937
September-06	1.15	0.1	1.26	0.74	0.1	0.85
October-06				0.84	0.1	0.95
November-06	1.02	0.576	1.606	1.19	0.497	1.697
January-07	0.671	0.1	0.781	0.572	0.1	0.682
July-07	6.1	7.85	13.96	2.32	0.05	2.38
August-07	5.6	0.12	5.73	0.53	0.05	0.59
September-07	4.96	3.31	8.28	0.51	0.05	0.57
October-07	0.57	0.97	1.54	0.25	0.03	0.28
November-07	2.55	1.52	4.07	0.25	0.03	0.28
December-07	5.87	2.87	8.74	0.91	0.03	0.94
January-08	5.74	2.42	8.16	0.67	0.07	0.74
February-08	5.2	1.29	6.49	0.53	0.25	0.78
March-08	1.3	4.04	5.34	0.25	0.25	0.5
April-08	0.03	0.03	0.05	0.03	0.03	0.05
May-08	0.03	0.03	0.05	0.03	0.03	0.05
June-08	0.53	0.03	0.56	0.68	0.03	0.71
August-08	1.48	4.91	6.39	0.9	0.03	0.93
September-08	2.93	1	3.93	0.55	0.03	0.58
October-08	0.25	0.03	0.28	0.51	0.03	0.54
November-08	0.82	1.45	2.27	0.25	0.03	0.28
December-08	0.25	2.91	3.16	0.25	0.43	0.68
January-09	0.25	0.33	0.58	0.25	0.03	0.28
February-09	1.11	0.53	1.64	0.25	0.03	0.28
March-09	0.25	0.9	1.15	0.25	0.03	0.28

Regional Stream Modeling Information

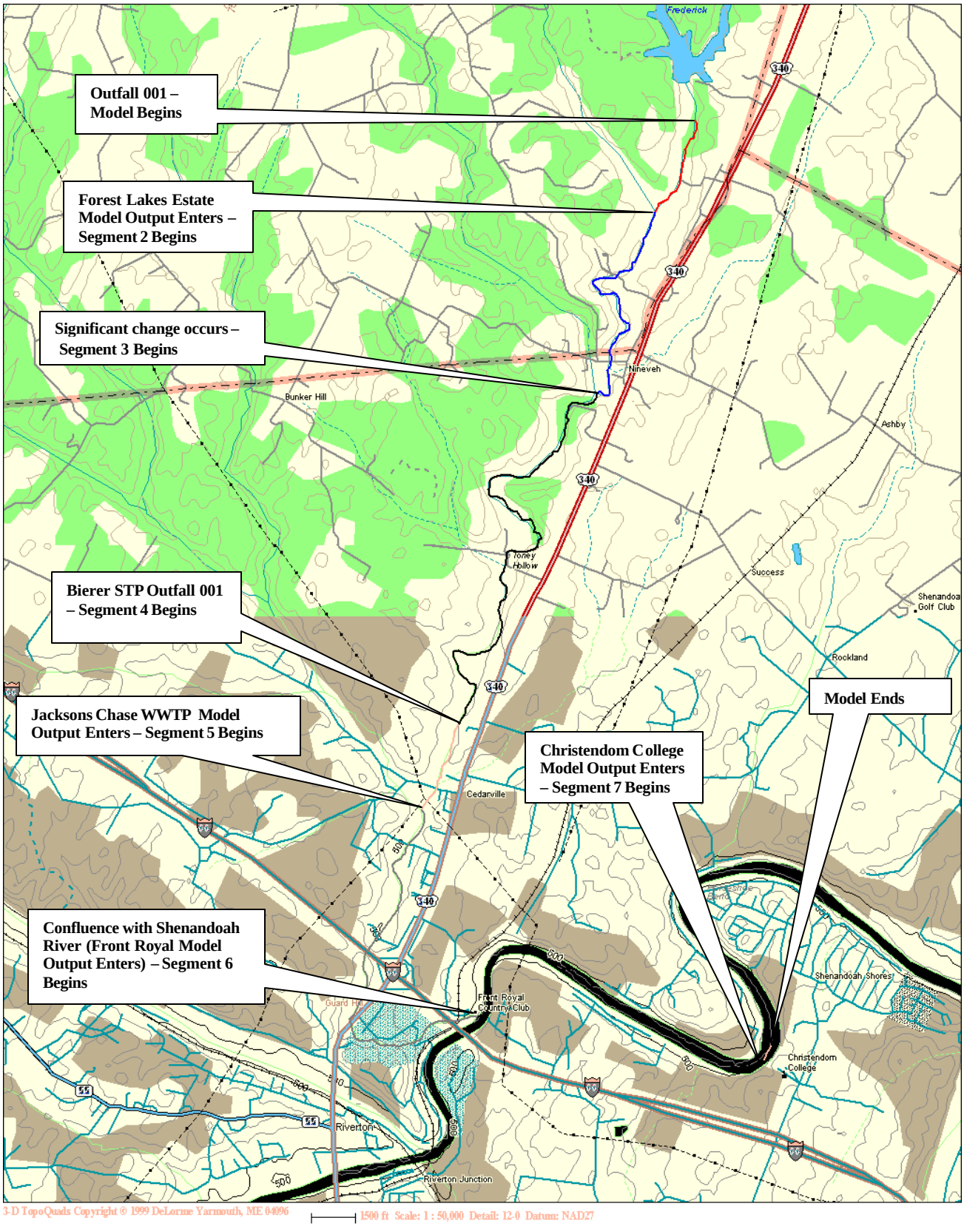
Segmentation and General Discussion:

Segment #	Starts at:	Elev. (ft)	Length (mi)	Inputs	Comments
1	Crooked Run STP	555	0.6	Design Flow = 0.25 MGD $CBOD_5$ = 7.5 mg/L TKN = 5 mg/L DO = 7.1 mg/L Temp = 26 C	Additional flow tiers of 0.375 MGD and 0.625 MGD. See model inputs attached for effluent data at each flow tier.
2	Confluence with Forest Lakes Estates Model Output	545	1.56	Flow = 0.15 MGD $CBOD_5$ = 3.03 mg/L TKN = 3 mg/L DO = 7.367 mg/L Temp = 24.8 C	Model assumes the highest flow tier for Forest Lakes Estates
3	Significant change occurs	520	3.5		
4	Confluence with Bierer STP Model Output	500	0.6	Design Flow = 0.35 MGD $CBOD_5$ = 17 mg/L TKN = 5 mg/L DO = 7 mg/L Temp = 25 C	
5	Confluence with Jacksons Chase WWTP Model Output	490	2.7	Design Flow = 0.039 MGD $CBOD_5$ = 5.38 mg/L TKN = 3.82 mg/L DO = 7.482 mg/L Temp = 25 C	
6	Confluence with the Shenandoah River (Front Royal STP Model Output)	460	2.35	Flow = 207.868 MGD $CBOD_5$ = 2.27 mg/L TKN = 3.32 mg/L DO = 7.155 mg/L Temp = 26.8 C	
7	Confluence with Christendom College Model Output	448.1	0.33	Design Flow = 0.05 MGD $cBOD_5$ = 23.4 mg/L TKN = 3.81 mg/L DO = 5.236 mg/L Temp = 26.7 C	
Model ends		448			

- The incremental flow in each segment was included in the tributary flow at the beginning of the following segment. The incremental and tributary flows were determined by performing drainage area comparisons.

- The model was stopped at the power plant dam impoundment. The $CBOD_u$ and DO concentrations had reached background concentrations at this point. Also, there is no evidence to indicate that stabilization of the remaining $nBOD_u$ will cause a reduction in the dissolved oxygen concentration below Water Quality Standard requirements in the impoundment.

Map of Modeled Segments:



Modeling Input Data: 0.25 MGD

Water Quality Standards Information
Stream Name: CROOKED RUN
River Basin: Potomac/Shenandoah Rivers Basin
Section: 1c
Class: IV - Mountainous Zones Waters
Special Standards: pH

Background Flow Information
Gauge Used: FFD dated 3/4/09
Gauge Drainage Area: 0.16 Sq.Mi.
Gauge 7Q10 Flow: 0 MGD
Headwater Drainage Area: 0.16 Sq.Mi.
Headwater 7Q10 Flow: 0 MGD (Net; includes Withdrawals/Discharges)
Withdrawal/Discharges: 0 MGD
Incremental Flow in Segments: 0 MGD/Sq.Mi.

Background Water Quality
Background Temperature: 21.2 Degrees C
Background cBOD5: 2 mg/l
Background TKN: 0 mg/l
Background D.O.: 7.852068 mg/l

Model Segmentation
Number of Segments: 7
Model Start Elevation: 555 ft above MSL
Model End Elevation: 448 ft above MSL

Segment Information for Segment 1

Definition Information
Segment Definition: A discharge enters.
Discharge Name: CROOKED RUN STP
VPDES Permit No.: VA0080080

Discharger Flow Information
Flow: 0.25 MGD
cBOD5: 7.5 mg/l
TKN: 5 mg/l
D.O.: 7.1 mg/l
Temperature: 26 Degrees C

Geographic Information
Segment Length: 0.6 miles
Upstream Drainage Area: 0.16 Sq.Mi.
Downstream Drainage Area: 0.16 Sq.Mi.
Upstream Elevation: 555 Ft.
Downstream Elevation: 545 Ft.

Hydraulic Information
Segment Width: 2 Ft.
Segment Depth: 0.5 Ft.
Segment Velocity: 0.4 Ft./Sec.
Segment Flow: 0.25 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 95
Percent Riffles: 5
Pool Depth: 0.5 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 2

Definition Information
Segment Definition: A discharge enters.
Discharge Name: FOREST LAKES ESTATES MODEL OUTPUT
VPDES Permit No.: VA0061964

Discharger Flow Information
Flow: 0.15 MGD
cBOD5: 3.03 mg/l
TKN: 3 mg/l
D.O.: 7.367 mg/l
Temperature: 24.8 Degrees C

Geographic Information
Segment Length: 1.56 miles
Upstream Drainage Area: 0.62 Sq.Mi.
Downstream Drainage Area: 0.62 Sq.Mi.
Upstream Elevation: 545 Ft.
Downstream Elevation: 520 Ft.

Hydraulic Information
Segment Width: 4 Ft.
Segment Depth: 0.5 Ft.
Segment Velocity: 0.3 Ft./Sec.
Segment Flow: 0.4 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 95
Percent Riffles: 5
Pool Depth: 0.5 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 3

Definition Information
Segment Definition: A significant change occurs.

Geographic Information
Segment Length: 3.5 miles
Upstream Drainage Area: 4.8 Sq.Mi.
Downstream Drainage Area: 4.8 Sq.Mi.
Upstream Elevation: 520 Ft.
Downstream Elevation: 500 Ft.

Hydraulic Information
Segment Width: 4 Ft.
Segment Depth: 0.4 Ft.
Segment Velocity: 0.4 Ft./Sec.
Segment Flow: 0.4 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 80
Percent Riffles: 20
Pool Depth: 0.45 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 4	**Segment Information for Segment 5**
Definition Information Segment Definition: A discharge enters. Discharge Name: BIERER STP VPDES Permit No.: VA0086100	Definition Information Segment Definition: A discharge enters. Discharge Name: JACKSONS CHASE WWTP MODEL OUTPUT VPDES Permit No.: VA0090247
Discharger Flow Information Flow: 0.35 MGD cBOD5: 17 mg/l TKN: 5 mg/l D.O.: 7 mg/l Temperature: 25 Degrees C	Discharger Flow Information Flow: 0.039 MGD cBOD5: 5.38 mg/l TKN: 3.82 mg/l D.O.: 7.482 mg/l Temperature: 25 Degrees C
Geographic Information Segment Length: 0.6 miles Upstream Drainage Area: 20.61 Sq.Mi. Downstream Drainage Area: 20.61 Sq.Mi. Upstream Elevation: 500 Ft. Downstream Elevation: 490 Ft.	Geographic Information Segment Length: 2.7 miles Upstream Drainage Area: 24.49 Sq.Mi. Downstream Drainage Area: 24.49 Sq.Mi. Upstream Elevation: 490 Ft. Downstream Elevation: 460 Ft.
Hydraulic Information Segment Width: 6 Ft. Segment Depth: 0.5 Ft. Segment Velocity: 0.4 Ft./Sec. Segment Flow: 0.75 MGD Incremental Flow: 0 MGD (Applied at end of segment.)	Hydraulic Information Segment Width: 8 Ft. Segment Depth: 0.5 Ft. Segment Velocity: 0.4 Ft./Sec. Segment Flow: 0.789 MGD Incremental Flow: 0 MGD (Applied at end of segment.)
Channel Information Cross Section: Irregular Character: Moderately Meandering Pool and Riffle: Yes Percent Pools: 80 Percent Riffles: 20 Pool Depth: 0.55 Ft. Riffle Depth: 0.05 Ft. Bottom Type: Gravel Sludge: None Plants: None Algae: None	Channel Information Cross Section: Irregular Character: Moderately Meandering Pool and Riffle: Yes Percent Pools: 80 Percent Riffles: 20 Pool Depth: 0.55 Ft. Riffle Depth: 0.05 Ft. Bottom Type: Gravel Sludge: None Plants: None Algae: None

Segment Information for Segment 6	**Segment Information for Segment 7**
Definition Information Segment Definition: A discharge enters. Discharge Name: FRONT ROYAL STP MODEL OUTPUT VPDES Permit No.: VA0062812	Definition Information Segment Definition: A discharge enters. Discharge Name: CHRISTENDOM COLLEGE MODEL OUTPUT VPDES Permit No.: VA0067067
Discharger Flow Information Flow: 207.868 MGD cBOD5: 2.27 mg/l TKN: 3.32 mg/l D.O.: 7.155 mg/l Temperature: 26.8 Degrees C	Discharger Flow Information Flow: 0.05 MGD cBOD5: 23.4 mg/l TKN: 3.81 mg/l D.O.: 5.236 mg/l Temperature: 26.7 Degrees C
Geographic Information Segment Length: 2.35 miles Upstream Drainage Area: 2754.14 Sq.Mi. Downstream Drainage Area: 2754.14 Sq.Mi. Upstream Elevation: 460 Ft. Downstream Elevation: 448.1 Ft.	Geographic Information Segment Length: 0.33 miles Upstream Drainage Area: 2754.14 Sq.Mi. Downstream Drainage Area: 2754.14 Sq.Mi. Upstream Elevation: 448.1 Ft. Downstream Elevation: 448 Ft.
Hydraulic Information Segment Width: 275 Ft. Segment Depth: 1.75 Ft. Segment Velocity: 0.7 Ft./Sec. Segment Flow: 208.657 MGD Incremental Flow: 0 MGD (Applied at end of segment.)	Hydraulic Information Segment Width: 275 Ft. Segment Depth: 1.8 Ft. Segment Velocity: 0.6 Ft./Sec. Segment Flow: 208.707 MGD Incremental Flow: 0 MGD (Applied at end of segment.)
Channel Information Cross Section: Wide Shallow Arc Character: Moderately Meandering Pool and Riffle: No Bottom Type: Silt Sludge: None Plants: None Algae: Only On Edges	Channel Information Cross Section: Wide Shallow Arc Character: Moderately Meandering Pool and Riffle: No Bottom Type: Silt Sludge: None Plants: None Algae: Only On Edges

Model Output: 0.25 MGD

Model is for CROOKED RUN.
Model starts at the CROOKED RUN STP discharge.

Background Data

7Q10 (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.852	21.2

Discharge/Tributary Input Data for Segment 1

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.25	7.5	5	7.1	26

Hydraulic Information for Segment 1

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.6	2	0.5	0.4

Initial Mix Values for Segment 1

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.25	7.1	18.75	8.66	8.045	26

Rate Constants for Segment 1. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.659	10	11.529	0.15	0.238	0	0

Output for Segment 1
Segment starts at CROOKED RUN STP

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
0	0	7.1	18.75	8.66
0.1	0.1	7.052	18.562	8.629
0.2	0.2	7.013	18.376	8.598
0.3	0.3	6.982	18.192	8.567
0.4	0.4	6.958	18.01	8.536
0.5	0.5	6.94	17.83	8.505
0.6	0.6	6.926	17.651	8.474

Discharge/Tributary Input Data for Segment 2

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.15	3.03	3	7.367	24.8

Incremental Flow Input Data for Segment 2

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.297	21.2

Hydraulic Information for Segment 2

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
1.56	4	0.5	0.3

Initial Mix Values for Segment 2

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.4	7.091	13.872	5.296	8.108	25.55

Rate Constants for Segment 2. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.645	9.615	10.968	0.15	0.23	0	0

Output for Segment 2

Segment starts at FOREST LAKES ESTATES MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
0.6	0	7.091	13.872	5.296
0.7	0.1	7.11	13.691	5.271
0.8	0.2	7.128	13.512	5.246
0.9	0.3	7.144	13.336	5.221
1	0.4	7.159	13.162	5.197
1.1	0.5	7.173	12.99	5.173
1.2	0.6	7.186	12.82	5.149
1.3	0.7	7.199	12.653	5.125
1.4	0.8	7.211	12.488	5.101
1.5	0.9	7.223	12.325	5.077
1.6	1	7.235	12.164	5.053
1.7	1.1	7.246	12.005	5.029
1.8	1.2	7.257	11.848	5.006
1.9	1.3	7.268	11.693	4.983
2	1.4	7.278	11.54	4.96
2.1	1.5	7.288	11.389	4.937
2.16	1.56	7.294	11.3	4.923

Discharge/Tributary Input Data for Segment 3

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	0	0	0	0

Incremental Flow Input Data for Segment 3

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.303	21.2

Hydraulic Information for Segment 3

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
3.5	4	0.4	0.4

Initial Mix Values for Segment 3

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.4	7.294	11.3	4.923	8.114	25.55

Rate Constants for Segment 3. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
1	1.29	3.429	3.911	0.3	0.46	0	0

Output for Segment 3

Segment starts at

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
2.16	0	7.294	11.3	4.923
2.26	0.1	7.094	11.079	4.889
2.36	0.2	6.91	10.863	4.855
2.46	0.3	6.741	10.651	4.821
2.56	0.4	6.586	10.443	4.787
2.66	0.5	6.444	10.239	4.753
2.76	0.6	6.315	10.039	4.72
2.86	0.7	6.197	9.843	4.687
2.96	0.8	6.09	9.651	4.654
3.06	0.9	5.993	9.463	4.621
3.16	1	5.905	9.278	4.589
3.26	1.1	5.826	9.097	4.557
3.36	1.2	5.755	8.919	4.525
3.46	1.3	5.692	8.745	4.493
3.56	1.4	5.636	8.574	4.462
3.66	1.5	5.587	8.407	4.431
3.76	1.6	5.544	8.243	4.4
3.86	1.7	5.507	8.082	4.369
3.96	1.8	5.475	7.924	4.338
4.06	1.9	5.448	7.769	4.308
4.16	2	5.426	7.617	4.278
4.26	2.1	5.409	7.468	4.248
4.36	2.2	5.396	7.322	4.218
4.46	2.3	5.386	7.179	4.188
4.56	2.4	5.38	7.039	4.159
4.66	2.5	5.377	6.902	4.13
4.76	2.6	5.377	6.767	4.101
4.86	2.7	5.38	6.635	4.072
4.96	2.8	5.385	6.505	4.043
5.06	2.9	5.393	6.378	4.015
5.16	3	5.403	6.253	3.987
5.26	3.1	5.415	6.131	3.959
5.36	3.2	5.428	6.011	3.931
5.46	3.3	5.443	5.894	3.903
5.56	3.4	5.46	5.779	3.876
5.66	3.5	5.478	5.666	3.849

Discharge/Tributary Input Data for Segment 4

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.35	17	5	7	25

Incremental Flow Input Data for Segment 4

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.337	21.2

Hydraulic Information for Segment 4

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.6	6	0.5	0.4

Initial Mix Values for Segment 4

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.75	6.188	22.855	6.094	8.152	25.29333

Rate Constants for Segment 4. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.7	0.893	10	11.338	0.15	0.225	0	0

Output for Segment 4
Segment starts at BIERER STP

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
5.66	0	6.188	22.855	6.094
5.76	0.1	6.197	22.545	6.073
5.86	0.2	6.208	22.24	6.052
5.96	0.3	6.222	21.939	6.031
6.06	0.4	6.237	21.642	6.01
6.16	0.5	6.253	21.349	5.989
6.26	0.6	6.271	21.06	5.968

Discharge/Tributary Input Data for Segment 5

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.039	5.38	3.82	7.482	25

Incremental Flow Input Data for Segment 5

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.344	21.2

Hydraulic Information for Segment 5

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
2.7	8	0.5	0.4

Initial Mix Values for Segment 5

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.789	6.331	20.684	5.849	8.16	25.27884

Rate Constants for Segment 5. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.7	0.892	6.667	7.556	0.15	0.225	0	0

Output for Segment 5

Segment starts at JACKSONS CHASE WWTP MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
6.26	0	6.331	20.684	5.849
6.36	0.1	6.247	20.404	5.829
6.46	0.2	6.176	20.128	5.809
6.56	0.3	6.116	19.856	5.789
6.66	0.4	6.066	19.587	5.769
6.76	0.5	6.025	19.322	5.749
6.86	0.6	5.992	19.06	5.729
6.96	0.7	5.966	18.802	5.709
7.06	0.8	5.946	18.547	5.689
7.16	0.9	5.932	18.296	5.669
7.26	1	5.923	18.048	5.65
7.36	1.1	5.918	17.804	5.631
7.46	1.2	5.917	17.563	5.612
7.56	1.3	5.919	17.325	5.593
7.66	1.4	5.924	17.09	5.574
7.76	1.5	5.931	16.859	5.555
7.86	1.6	5.94	16.631	5.536
7.96	1.7	5.951	16.406	5.517
8.06	1.8	5.964	16.184	5.498
8.16	1.9	5.979	15.965	5.479
8.26	2	5.995	15.749	5.46
8.36	2.1	6.012	15.536	5.441
8.46	2.2	6.03	15.326	5.422
8.56	2.3	6.049	15.119	5.403
8.66	2.4	6.068	14.914	5.384
8.76	2.5	6.088	14.712	5.366
8.86	2.6	6.108	14.513	5.348
8.96	2.7	6.129	14.317	5.33

Discharge/Tributary Input Data for Segment 6

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
207.868	2.27	3.32	7.155	26.8

Incremental Flow Input Data for Segment 6

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.175	21.2

Hydraulic Information for Segment 6

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
2.35	275	1.75	0.7

Initial Mix Values for Segment 6

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
208.657	7.151	5.708	1.401	7.972	26.79425

Rate Constants for Segment 6. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.683	3.038	3.57	0.15	0.253	0	0

Output for Segment 6

Segment starts at FRONT ROYAL STP MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
8.96	0	7.151	5.708	1.401
9.06	0.1	7.14	5.674	1.398
9.16	0.2	7.129	5.64	1.395
9.26	0.3	7.119	5.606	1.392
9.36	0.4	7.109	5.573	1.389
9.46	0.5	7.1	5.54	1.386
9.56	0.6	7.091	5.507	1.383
9.66	0.7	7.083	5.474	1.38
9.76	0.8	7.075	5.441	1.377
9.86	0.9	7.068	5.409	1.374
9.96	1	7.061	5.377	1.371
10.06	1.1	7.054	5.345	1.368
10.16	1.2	7.048	5.313	1.365
10.26	1.3	7.042	5.281	1.362
10.36	1.4	7.037	5.25	1.359
10.46	1.5	7.032	5.219	1.356
10.56	1.6	7.027	5.188	1.353
10.66	1.7	7.023	5.157	1.35
10.76	1.8	7.019	5.126	1.347
10.86	1.9	7.015	5.096	1.344
10.96	2	7.012	5.066	1.341
11.06	2.1	7.009	5.036	1.338
11.16	2.2	7.006	5.006	1.335
11.26	2.3	7.003	5	1.332
11.31	2.35	7.017	5	1.331

Discharge/Tributary Input Data for Segment 7

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.05	23.4	3.81	5.236	26.7

Incremental Flow Input Data for Segment 7

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.176	21.2

Hydraulic Information for Segment 7

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.33	275	1.8	0.6

Initial Mix Values for Segment 7

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
208.707	7.017	5.013	1.332	7.974	26.79422

Rate Constants for Segment 7. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.683	0.182	0.214	0.15	0.253	0	0

Output for Segment 7

Segment starts at CHRISTENDOM COLLEGE MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	
11.31	0	7.017	5.013	1.332	
11.41	0.1	6.981	5	1.329	
11.51	0.2	6.98	5	1.326	
11.61	0.3	6.979	5	1.323	
11.64	0.33	6.979	5	1.322	END OF FILE

Modeling Input Data: 0.375 MGD

Water Quality Standards Information
Stream Name: CROOKED RUN
River Basin: Potomac/Shenandoah Rivers Basin
Section: 1c
Class: IV - Mountainous Zones Waters
Special Standards: pH

Background Flow Information
Gauge Used: FFD dated 3/4/09
Gauge Drainage Area: 0.16 Sq.Mi.
Gauge 7Q10 Flow: 0 MGD
Headwater Drainage Area: 0.16 Sq.Mi.
Headwater 7Q10 Flow: 0 MGD (Net; includes Withdrawals/Discharges)
Withdrawal/Discharges: 0 MGD
Incremental Flow in Segments: 0 MGD/Sq.Mi.

Background Water Quality
Background Temperature: 21.2 Degrees C
Background cBOD5: 2 mg/l
Background TKN: 0 mg/l
Background D.O.: 7.852068 mg/l

Model Segmentation
Number of Segments: 7
Model Start Elevation: 555 ft above MSL
Model End Elevation: 448 ft above MSL

Segment Information for Segment 1

Definition Information
Segment Definition: A discharge enters.
Discharge Name: CROOKED RUN STP
VPDES Permit No.: VA0080080

Discharger Flow Information
Flow: 0.375 MGD
cBOD5: 7.7 mg/l
TKN: 5 mg/l
D.O.: 6 mg/l
Temperature: 26 Degrees C

Geographic Information
Segment Length: 0.6 miles
Upstream Drainage Area: 0.16 Sq.Mi.
Downstream Drainage Area: 0.16 Sq.Mi.
Upstream Elevation: 555 Ft.
Downstream Elevation: 545 Ft.

Hydraulic Information
Segment Width: 3 Ft.
Segment Depth: 0.5 Ft.
Segment Velocity: 0.4 Ft./Sec.
Segment Flow: 0.375 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 95
Percent Riffles: 5
Pool Depth: 0.5 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 2

Definition Information
Segment Definition: A discharge enters.
Discharge Name: FOREST LAKES ESTATES MODEL OUTPUT
VPDES Permit No.: VA0061964

Discharger Flow Information
Flow: 0.15 MGD
cBOD5: 3.03 mg/l
TKN: 3 mg/l
D.O.: 7.367 mg/l
Temperature: 24.8 Degrees C

Geographic Information
Segment Length: 1.56 miles
Upstream Drainage Area: 0.62 Sq.Mi.
Downstream Drainage Area: 0.62 Sq.Mi.
Upstream Elevation: 545 Ft.
Downstream Elevation: 520 Ft.

Hydraulic Information
Segment Width: 5 Ft.
Segment Depth: 0.5 Ft.
Segment Velocity: 0.3 Ft./Sec.
Segment Flow: 0.525 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 95
Percent Riffles: 5
Pool Depth: 0.5 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 3

Definition Information
Segment Definition: A significant change occurs.

Geographic Information
Segment Length: 3.5 miles
Upstream Drainage Area: 4.8 Sq.Mi.
Downstream Drainage Area: 4.8 Sq.Mi.
Upstream Elevation: 520 Ft.
Downstream Elevation: 500 Ft.

Hydraulic Information
Segment Width: 5 Ft.
Segment Depth: 0.4 Ft.
Segment Velocity: 0.4 Ft./Sec.
Segment Flow: 0.525 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 80
Percent Riffles: 20
Pool Depth: 0.45 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 4	**Segment Information for Segment 5**
Definition Information Segment Definition: A discharge enters. Discharge Name: BIERER STP VPDES Permit No.: VA0086100	Definition Information Segment Definition: A discharge enters. Discharge Name: JACKSONS CHASE WWTP MODEL OUTPUT VPDES Permit No.: VA0090247
Discharger Flow Information Flow: 0.35 MGD cBOD5: 17 mg/l TKN: 5 mg/l D.O.: 7 mg/l Temperature: 25 Degrees C	Discharger Flow Information Flow: 0.039 MGD cBOD5: 5.38 mg/l TKN: 3.82 mg/l D.O.: 7.482 mg/l Temperature: 25 Degrees C
Geographic Information Segment Length: 0.6 miles Upstream Drainage Area: 20.61 Sq.Mi. Downstream Drainage Area: 20.61 Sq.Mi. Upstream Elevation: 500 Ft. Downstream Elevation: 490 Ft.	Geographic Information Segment Length: 2.7 miles Upstream Drainage Area: 24.49 Sq.Mi. Downstream Drainage Area: 24.49 Sq.Mi. Upstream Elevation: 490 Ft. Downstream Elevation: 460 Ft.
Hydraulic Information Segment Width: 7 Ft. Segment Depth: 0.5 Ft. Segment Velocity: 0.4 Ft./Sec. Segment Flow: 0.875 MGD Incremental Flow: 0 MGD (Applied at end of segment.)	Hydraulic Information Segment Width: 8 Ft. Segment Depth: 0.5 Ft. Segment Velocity: 0.4 Ft./Sec. Segment Flow: 0.914 MGD Incremental Flow: 0 MGD (Applied at end of segment.)
Channel Information Cross Section: Irregular Character: Moderately Meandering Pool and Riffle: Yes Percent Pools: 80 Percent Riffles: 20 Pool Depth: 0.55 Ft. Riffle Depth: 0.05 Ft. Bottom Type: Gravel Sludge: None Plants: None Algae: None	Channel Information Cross Section: Irregular Character: Moderately Meandering Pool and Riffle: Yes Percent Pools: 80 Percent Riffles: 20 Pool Depth: 0.55 Ft. Riffle Depth: 0.05 Ft. Bottom Type: Gravel Sludge: None Plants: None Algae: None

Segment Information for Segment 6	**Segment Information for Segment 7**
Definition Information Segment Definition: A discharge enters. Discharge Name: FRONT ROYAL STP MODEL OUTPUT VPDES Permit No.: VA0062812	Definition Information Segment Definition: A discharge enters. Discharge Name: CHRISTENDOM COLLEGE MODEL OUTPUT VPDES Permit No.: VA0067067
Discharger Flow Information Flow: 209.168 MGD cBOD5: 2.26 mg/l TKN: 3.13 mg/l D.O.: 7.17 mg/l Temperature: 26.8 Degrees C	Discharger Flow Information Flow: 0.05 MGD cBOD5: 23.4 mg/l TKN: 3.81 mg/l D.O.: 5.236 mg/l Temperature: 26.7 Degrees C
Geographic Information Segment Length: 2.35 miles Upstream Drainage Area: 2754.14 Sq.Mi. Downstream Drainage Area: 2754.14 Sq.Mi. Upstream Elevation: 460 Ft. Downstream Elevation: 448.1 Ft.	Geographic Information Segment Length: 0.33 miles Upstream Drainage Area: 2754.14 Sq.Mi. Downstream Drainage Area: 2754.14 Sq.Mi. Upstream Elevation: 448.1 Ft. Downstream Elevation: 448 Ft.
Hydraulic Information Segment Width: 275 Ft. Segment Depth: 1.75 Ft. Segment Velocity: 0.7 Ft./Sec. Segment Flow: 210.082 MGD Incremental Flow: 0 MGD (Applied at end of segment.)	Hydraulic Information Segment Width: 275 Ft. Segment Depth: 1.8 Ft. Segment Velocity: 0.6 Ft./Sec. Segment Flow: 210.132 MGD Incremental Flow: 0 MGD (Applied at end of segment.)
Channel Information Cross Section: Wide Shallow Arc Character: Moderately Meandering Pool and Riffle: No Bottom Type: Silt Sludge: None Plants: None Algae: Only On Edges	Channel Information Cross Section: Wide Shallow Arc Character: Moderately Meandering Pool and Riffle: No Bottom Type: Silt Sludge: None Plants: None Algae: Only On Edges

Model Output: 0.375 MGD

Model is for CROOKED RUN.
Model starts at the CROOKED RUN STP discharge.

Background Data

7Q10 (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.852	21.2

Discharge/Tributary Input Data for Segment 1

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.375	7.7	5	6	26

Hydraulic Information for Segment 1

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.6	3	0.5	0.4

Initial Mix Values for Segment 1

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.375	6	19.25	8.66	8.045	26

Rate Constants for Segment 1. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.659	10	11.529	0.15	0.238	0	0

Output for Segment 1
Segment starts at CROOKED RUN STP

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
0	0	6	19.25	8.66
0.1	0.1	6.125	19.057	8.629
0.2	0.2	6.231	18.866	8.598
0.3	0.3	6.322	18.677	8.567
0.4	0.4	6.4	18.49	8.536
0.5	0.5	6.467	18.305	8.505
0.6	0.6	6.525	18.122	8.474

Discharge/Tributary Input Data for Segment 2

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.15	3.03	3	7.367	24.8

Incremental Flow Input Data for Segment 2

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.284	21.2

Hydraulic Information for Segment 2

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
1.56	5	0.5	0.3

Initial Mix Values for Segment 2

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.525	6.766	15.109	6.053	8.094	25.65714

Rate Constants for Segment 2. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.648	9.615	10.996	0.15	0.232	0	0

Output for Segment 2

Segment starts at FOREST LAKES ESTATES MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
0.6	0	6.766	15.109	6.053
0.7	0.1	6.829	14.911	6.024
0.8	0.2	6.882	14.715	5.996
0.9	0.3	6.927	14.522	5.968
1	0.4	6.965	14.331	5.94
1.1	0.5	6.998	14.143	5.912
1.2	0.6	7.027	13.957	5.884
1.3	0.7	7.052	13.774	5.856
1.4	0.8	7.074	13.593	5.828
1.5	0.9	7.094	13.415	5.801
1.6	1	7.112	13.239	5.774
1.7	1.1	7.129	13.065	5.747
1.8	1.2	7.145	12.894	5.72
1.9	1.3	7.16	12.725	5.693
2	1.4	7.174	12.558	5.666
2.1	1.5	7.187	12.393	5.639
2.16	1.56	7.195	12.295	5.623

Discharge/Tributary Input Data for Segment 3

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	0	0	0	0

Incremental Flow Input Data for Segment 3

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.29	21.2

Hydraulic Information for Segment 3

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
3.5	5	0.4	0.4

Initial Mix Values for Segment 3

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.525	7.195	12.295	5.623	8.1	25.65714

Rate Constants for Segment 3. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
1	1.297	3.429	3.921	0.35	0.541	0	0

Output for Segment 3

Segment starts at

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
2.16	0	7.195	12.295	5.623
2.26	0.1	6.969	12.054	5.577
2.36	0.2	6.761	11.818	5.531
2.46	0.3	6.57	11.586	5.485
2.56	0.4	6.395	11.359	5.44
2.66	0.5	6.234	11.136	5.395
2.76	0.6	6.087	10.918	5.351
2.86	0.7	5.953	10.704	5.307
2.96	0.8	5.832	10.494	5.263
3.06	0.9	5.722	10.288	5.22
3.16	1	5.623	10.086	5.177
3.26	1.1	5.534	9.888	5.134
3.36	1.2	5.454	9.694	5.092
3.46	1.3	5.383	9.504	5.05
3.56	1.4	5.32	9.318	5.008
3.66	1.5	5.264	9.135	4.967
3.76	1.6	5.215	8.956	4.926
3.86	1.7	5.173	8.78	4.885
3.96	1.8	5.137	8.608	4.845
4.06	1.9	5.107	8.439	4.805
4.16	2	5.082	8.273	4.765
4.26	2.1	5.062	8.111	4.726
4.36	2.2	5.046	7.952	4.687
4.46	2.3	5.035	7.796	4.648
4.56	2.4	5.028	7.643	4.61
4.66	2.5	5.024	7.493	4.572
4.76	2.6	5.024	7.346	4.534
4.86	2.7	5.027	7.202	4.497
4.96	2.8	5.033	7.061	4.46
5.06	2.9	5.041	6.922	4.423
5.16	3	5.052	6.786	4.387
5.26	3.1	5.065	6.653	4.351
5.36	3.2	5.08	6.522	4.315
5.46	3.3	5.097	6.394	4.279
5.56	3.4	5.116	6.269	4.244
5.66	3.5	5.136	6.146	4.209

Discharge/Tributary Input Data for Segment 4

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.35	17	5	7	25

Incremental Flow Input Data for Segment 4

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.325	21.2

Hydraulic Information for Segment 4

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.6	7	0.5	0.4

Initial Mix Values for Segment 4

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.875	5.882	20.688	5.989	8.139	25.39429

Rate Constants for Segment 4. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.7	0.897	10	11.365	0.15	0.227	0	0

Output for Segment 4
Segment starts at BIERER STP

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
5.66	0	5.882	20.688	5.989
5.76	0.1	5.964	20.406	5.968
5.86	0.2	6.037	20.128	5.947
5.96	0.3	6.102	19.854	5.926
6.06	0.4	6.16	19.584	5.905
6.16	0.5	6.212	19.318	5.885
6.26	0.6	6.259	19.055	5.865

Discharge/Tributary Input Data for Segment 5

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.039	5.38	3.82	7.482	25

Incremental Flow Input Data for Segment 5

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.332	21.2

Hydraulic Information for Segment 5

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
2.7	8	0.5	0.4

Initial Mix Values for Segment 5

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.914	6.311	18.816	5.766	8.147	25.37746

Rate Constants for Segment 5. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.64	6.667	7.573	0.15	0.227	0	0

Output for Segment 5

Segment starts at JACKSONS CHASE WWTP MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
6.26	0	6.311	18.816	5.766
6.36	0.1	6.32	18.633	5.746
6.46	0.2	6.33	18.452	5.726
6.56	0.3	6.34	18.272	5.706
6.66	0.4	6.351	18.094	5.686
6.76	0.5	6.362	17.918	5.666
6.86	0.6	6.374	17.744	5.646
6.96	0.7	6.386	17.571	5.626
7.06	0.8	6.399	17.4	5.607
7.16	0.9	6.412	17.231	5.588
7.26	1	6.425	17.063	5.569
7.36	1.1	6.438	16.897	5.55
7.46	1.2	6.451	16.733	5.531
7.56	1.3	6.464	16.57	5.512
7.66	1.4	6.478	16.409	5.493
7.76	1.5	6.492	16.249	5.474
7.86	1.6	6.506	16.091	5.455
7.96	1.7	6.52	15.934	5.436
8.06	1.8	6.534	15.779	5.417
8.16	1.9	6.548	15.625	5.398
8.26	2	6.561	15.473	5.379
8.36	2.1	6.575	15.322	5.36
8.46	2.2	6.588	15.173	5.341
8.56	2.3	6.601	15.025	5.323
8.66	2.4	6.614	14.879	5.305
8.76	2.5	6.627	14.734	5.287
8.86	2.6	6.64	14.591	5.269
8.96	2.7	6.653	14.449	5.251

Discharge/Tributary Input Data for Segment 6

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
209.168	2.26	3.13	7.17	26.8

Incremental Flow Input Data for Segment 6

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.175	21.2

Hydraulic Information for Segment 6

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
2.35	275	1.75	0.7

Initial Mix Values for Segment 6

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
210.082	7.168	5.688	0.583	7.972	26.79381

Rate Constants for Segment 6. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.683	3.038	3.569	0.15	0.253	0	0

Output for Segment 6

Segment starts at FRONT ROYAL STP MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
8.96	0	7.168	5.688	0.583
9.06	0.1	7.158	5.654	0.582
9.16	0.2	7.149	5.62	0.581
9.26	0.3	7.14	5.587	0.58
9.36	0.4	7.132	5.554	0.579
9.46	0.5	7.124	5.521	0.578
9.56	0.6	7.116	5.488	0.577
9.66	0.7	7.109	5.455	0.576
9.76	0.8	7.102	5.423	0.575
9.86	0.9	7.096	5.391	0.574
9.96	1	7.09	5.359	0.573
10.06	1.1	7.084	5.327	0.572
10.16	1.2	7.079	5.295	0.571
10.26	1.3	7.074	5.264	0.57
10.36	1.4	7.07	5.233	0.569
10.46	1.5	7.066	5.202	0.568
10.56	1.6	7.062	5.171	0.567
10.66	1.7	7.058	5.14	0.566
10.76	1.8	7.055	5.109	0.565
10.86	1.9	7.052	5.079	0.564
10.96	2	7.049	5.049	0.563
11.06	2.1	7.047	5.019	0.562
11.16	2.2	7.045	5	0.561
11.26	2.3	7.072	5	0.56
11.31	2.35	7.085	5	0.559

Discharge/Tributary Input Data for Segment 7

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.05	23.4	3.81	5.236	26.7

Incremental Flow Input Data for Segment 7

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.177	21.2

Hydraulic Information for Segment 7

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.33	275	1.8	0.6

Initial Mix Values for Segment 7

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
210.132	7.085	5.013	0.56	7.974	26.79379

Rate Constants for Segment 7. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.683	0.182	0.214	0.15	0.253	0	0

Output for Segment 7

Segment starts at CHRISTENDOM COLLEGE MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	
11.31	0	7.085	5.013	0.56	
11.41	0.1	7.051	5	0.559	
11.51	0.2	7.052	5	0.558	
11.61	0.3	7.053	5	0.557	
11.64	0.33	7.053	5	0.557	END OF FILE

Modeling Input Data: 0.625 MGD

Water Quality Standards Information
Stream Name: CROOKED RUN
River Basin: Potomac/Shenandoah Rivers Basin
Section: 1c
Class: IV - Mountainous Zones Waters
Special Standards: pH

Background Flow Information
Gauge Used: FFD dated 3/4/09
Gauge Drainage Area: 0.16 Sq.Mi.
Gauge 7Q10 Flow: 0 MGD
Headwater Drainage Area: 0.16 Sq.Mi.
Headwater 7Q10 Flow: 0 MGD (Net; includes Withdrawals/Discharges)
Withdrawal/Discharges: 0 MGD
Incremental Flow in Segments: 0 MGD/Sq.Mi.

Background Water Quality
Background Temperature: 21.2 Degrees C
Background cBOD5: 2 mg/l
Background TKN: 0 mg/l
Background D.O.: 7.852068 mg/l

Model Segmentation
Number of Segments: 7
Model Start Elevation: 555 ft above MSL
Model End Elevation: 448 ft above MSL

Segment Information for Segment 1

Definition Information
Segment Definition: A discharge enters.
Discharge Name: CROOKED RUN STP
VPDES Permit No.: VA0080080

Discharger Flow Information
Flow: 0.625 MGD
cBOD5: 6.8 mg/l
TKN: 5 mg/l
D.O.: 6 mg/l
Temperature: 26 Degrees C

Geographic Information
Segment Length: 0.6 miles
Upstream Drainage Area: 0.16 Sq.Mi.
Downstream Drainage Area: 0.16 Sq.Mi.
Upstream Elevation: 555 Ft.
Downstream Elevation: 545 Ft.

Hydraulic Information
Segment Width: 4 Ft.
Segment Depth: 0.5 Ft.
Segment Velocity: 0.4 Ft./Sec.
Segment Flow: 0.625 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 95
Percent Riffles: 5
Pool Depth: 0.5 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 2

Definition Information
Segment Definition: A discharge enters.
Discharge Name: FOREST LAKES ESTATES MODEL OUTPUT
VPDES Permit No.: VA0061964

Discharger Flow Information
Flow: 0.15 MGD
cBOD5: 3.03 mg/l
TKN: 3 mg/l
D.O.: 7.367 mg/l
Temperature: 24.8 Degrees C

Geographic Information
Segment Length: 1.56 miles
Upstream Drainage Area: 0.62 Sq.Mi.
Downstream Drainage Area: 0.62 Sq.Mi.
Upstream Elevation: 545 Ft.
Downstream Elevation: 520 Ft.

Hydraulic Information
Segment Width: 6 Ft.
Segment Depth: 0.5 Ft.
Segment Velocity: 0.3 Ft./Sec.
Segment Flow: 0.775 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 95
Percent Riffles: 5
Pool Depth: 0.5 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 3

Definition Information
Segment Definition: A significant change occurs.

Geographic Information
Segment Length: 3.5 miles
Upstream Drainage Area: 4.8 Sq.Mi.
Downstream Drainage Area: 4.8 Sq.Mi.
Upstream Elevation: 520 Ft.
Downstream Elevation: 500 Ft.

Hydraulic Information
Segment Width: 6 Ft.
Segment Depth: 0.4 Ft.
Segment Velocity: 0.4 Ft./Sec.
Segment Flow: 0.775 MGD
Incremental Flow: 0 MGD (Applied at end of segment.)

Channel Information
Cross Section: Irregular
Character: Moderately Meandering
Pool and Riffle: Yes
Percent Pools: 80
Percent Riffles: 20
Pool Depth: 0.45 Ft.
Riffle Depth: 0.04 Ft.
Bottom Type: Gravel
Sludge: None
Plants: None
Algae: None

Segment Information for Segment 4	**Segment Information for Segment 5**
Definition Information Segment Definition: A discharge enters. Discharge Name: BIERER STP VPDES Permit No.: VA0086100	Definition Information Segment Definition: A discharge enters. Discharge Name: JACKSONS CHASE WWTP MODEL OUTPUT VPDES Permit No.: VA0090247
Discharger Flow Information Flow: 0.35 MGD cBOD5: 17 mg/l TKN: 5 mg/l D.O.: 7 mg/l Temperature: 25 Degrees C	Discharger Flow Information Flow: 0.039 MGD cBOD5: 5.38 mg/l TKN: 3.82 mg/l D.O.: 7.482 mg/l Temperature: 25 Degrees C
Geographic Information Segment Length: 0.6 miles Upstream Drainage Area: 20.61 Sq.Mi. Downstream Drainage Area: 20.61 Sq.Mi. Upstream Elevation: 500 Ft. Downstream Elevation: 490 Ft.	Geographic Information Segment Length: 2.7 miles Upstream Drainage Area: 24.49 Sq.Mi. Downstream Drainage Area: 24.49 Sq.Mi. Upstream Elevation: 490 Ft. Downstream Elevation: 460 Ft.
Hydraulic Information Segment Width: 8 Ft. Segment Depth: 0.5 Ft. Segment Velocity: 0.4 Ft./Sec. Segment Flow: 1.125 MGD Incremental Flow: 0 MGD (Applied at end of segment.)	Hydraulic Information Segment Width: 8 Ft. Segment Depth: 0.5 Ft. Segment Velocity: 0.4 Ft./Sec. Segment Flow: 1.164 MGD Incremental Flow: 0 MGD (Applied at end of segment.)
Channel Information Cross Section: Irregular Character: Moderately Meandering Pool and Riffle: Yes Percent Pools: 80 Percent Riffles: 20 Pool Depth: 0.55 Ft. Riffle Depth: 0.05 Ft. Bottom Type: Gravel Sludge: None Plants: None Algae: None	Channel Information Cross Section: Irregular Character: Moderately Meandering Pool and Riffle: Yes Percent Pools: 80 Percent Riffles: 20 Pool Depth: 0.55 Ft. Riffle Depth: 0.05 Ft. Bottom Type: Gravel Sludge: None Plants: None Algae: None

Segment Information for Segment 6	**Segment Information for Segment 7**
Definition Information Segment Definition: A discharge enters. Discharge Name: FRONT ROYAL STP MODEL OUTPUT VPDES Permit No.: VA0062812	Definition Information Segment Definition: A discharge enters. Discharge Name: CHRISTENDOM COLLEGE MODEL OUTPUT VPDES Permit No.: VA0067067
Discharger Flow Information Flow: 209.168 MGD cBOD5: 2.26 mg/l TKN: 3.13 mg/l D.O.: 7.17 mg/l Temperature: 26.8 Degrees C	Discharger Flow Information Flow: 0.05 MGD cBOD5: 23.4 mg/l TKN: 3.81 mg/l D.O.: 5.236 mg/l Temperature: 26.7 Degrees C
Geographic Information Segment Length: 2.35 miles Upstream Drainage Area: 2754.14 Sq.Mi. Downstream Drainage Area: 2754.14 Sq.Mi. Upstream Elevation: 460 Ft. Downstream Elevation: 448.1 Ft.	Geographic Information Segment Length: 0.33 miles Upstream Drainage Area: 2754.14 Sq.Mi. Downstream Drainage Area: 2754.14 Sq.Mi. Upstream Elevation: 448.1 Ft. Downstream Elevation: 448 Ft.
Hydraulic Information Segment Width: 275 Ft. Segment Depth: 1.75 Ft. Segment Velocity: 0.7 Ft./Sec. Segment Flow: 210.332 MGD Incremental Flow: 0 MGD (Applied at end of segment.)	Hydraulic Information Segment Width: 275 Ft. Segment Depth: 1.8 Ft. Segment Velocity: 0.6 Ft./Sec. Segment Flow: 210.382 MGD Incremental Flow: 0 MGD (Applied at end of segment.)
Channel Information Cross Section: Wide Shallow Arc Character: Moderately M eandering Pool and Riffle: No Bottom Type: Silt Sludge: None Plants: None Algae: Only On Edges	Channel Information Cross Section: Wide Shallow Arc Character: Moderately Meandering Pool and Riffle: No Bottom Type: Silt Sludge: None Plants: None Algae: Only On Edges

Model Output: 0.625 MGD

Model is for CROOKED RUN.
Model starts at the CROOKED RUN STP discharge.

Background Data

7Q10 (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.852	21.2

Discharge/Tributary Input Data for Segment 1

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.625	6.8	5	6	26

Hydraulic Information for Segment 1

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.6	4	0.5	0.4

Initial Mix Values for Segment 1

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.625	6	17	8.66	8.045	26

Rate Constants for Segment 1. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.659	10	11.529	0.15	0.238	0	0

Output for Segment 1
Segment starts at CROOKED RUN STP

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
0	0	6	17	8.66
0.1	0.1	6.145	16.83	8.629
0.2	0.2	6.269	16.661	8.598
0.3	0.3	6.374	16.494	8.567
0.4	0.4	6.464	16.329	8.536
0.5	0.5	6.541	16.166	8.505
0.6	0.6	6.607	16.004	8.474

Discharge/Tributary Input Data for Segment 2

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.15	3.03	3	7.367	24.8

Incremental Flow Input Data for Segment 2

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.271	21.2

Hydraulic Information for Segment 2

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
1.56	6	0.5	0.3

Initial Mix Values for Segment 2

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.775	6.754	14.373	6.834	8.079	25.76774

Rate Constants for Segment 2. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.652	9.615	11.025	0.15	0.234	0	0

Output for Segment 2

Segment starts at FOREST LAKES ESTATES MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
0.6	0	6.754	14.373	6.834
0.7	0.1	6.822	14.183	6.802
0.8	0.2	6.878	13.996	6.77
0.9	0.3	6.926	13.811	6.738
1	0.4	6.966	13.629	6.706
1.1	0.5	7	13.449	6.674
1.2	0.6	7.03	13.272	6.642
1.3	0.7	7.056	13.097	6.61
1.4	0.8	7.079	12.924	6.579
1.5	0.9	7.1	12.754	6.548
1.6	1	7.119	12.586	6.517
1.7	1.1	7.136	12.42	6.486
1.8	1.2	7.151	12.256	6.455
1.9	1.3	7.166	12.094	6.424
2	1.4	7.18	11.935	6.393
2.1	1.5	7.193	11.778	6.363
2.16	1.56	7.2	11.685	6.345

Discharge/Tributary Input Data for Segment 3

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	0	0	0	0

Incremental Flow Input Data for Segment 3

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.277	21.2

Hydraulic Information for Segment 3

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
3.5	6	0.4	0.4

Initial Mix Values for Segment 3

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
0.775	7.2	11.685	6.345	8.086	25.76774

Rate Constants for Segment 3. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
1	1.303	3.429	3.931	0.35	0.546	0	0

Output for Segment 3

Segment starts at

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
2.16	0	7.2	11.685	6.345
2.26	0.1	6.977	11.455	6.292
2.36	0.2	6.772	11.229	6.24
2.46	0.3	6.583	11.008	6.188
2.56	0.4	6.41	10.791	6.137
2.66	0.5	6.252	10.578	6.086
2.76	0.6	6.107	10.369	6.035
2.86	0.7	5.975	10.165	5.985
2.96	0.8	5.855	9.965	5.935
3.06	0.9	5.747	9.769	5.886
3.16	1	5.649	9.576	5.837
3.26	1.1	5.561	9.387	5.789
3.36	1.2	5.482	9.202	5.741
3.46	1.3	5.411	9.021	5.693
3.56	1.4	5.348	8.843	5.646
3.66	1.5	5.293	8.669	5.599
3.76	1.6	5.245	8.498	5.553
3.86	1.7	5.203	8.33	5.507
3.96	1.8	5.167	8.166	5.461
4.06	1.9	5.137	8.005	5.416
4.16	2	5.112	7.847	5.371
4.26	2.1	5.092	7.692	5.326
4.36	2.2	5.076	7.54	5.282
4.46	2.3	5.065	7.391	5.238
4.56	2.4	5.057	7.245	5.195
4.66	2.5	5.053	7.102	5.152
4.76	2.6	5.052	6.962	5.109
4.86	2.7	5.054	6.825	5.067
4.96	2.8	5.059	6.69	5.025
5.06	2.9	5.067	6.558	4.983
5.16	3	5.077	6.429	4.942
5.26	3.1	5.09	6.302	4.901
5.36	3.2	5.105	6.178	4.86
5.46	3.3	5.121	6.056	4.82
5.56	3.4	5.139	5.937	4.78
5.66	3.5	5.159	5.82	4.74

Discharge/Tributary Input Data for Segment 4

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.35	17	5	7	25

Incremental Flow Input Data for Segment 4

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.309	21.2

Hydraulic Information for Segment 4

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.6	8	0.5	0.4

Initial Mix Values for Segment 4

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
1.125	5.732	17.232	5.96	8.121	25.52889

Rate Constants for Segment 4. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.645	10	11.401	0.15	0.23	0	0

Output for Segment 4
Segment starts at BIERER STP

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
5.66	0	5.732	17.232	5.96
5.76	0.1	5.94	17.063	5.939
5.86	0.2	6.116	16.896	5.918
5.96	0.3	6.266	16.73	5.897
6.06	0.4	6.393	16.566	5.876
6.16	0.5	6.501	16.404	5.855
6.26	0.6	6.594	16.243	5.835

Discharge/Tributary Input Data for Segment 5

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.039	5.38	3.82	7.482	25

Incremental Flow Input Data for Segment 5

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.316	21.2

Hydraulic Information for Segment 5

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
2.7	8	0.5	0.4

Initial Mix Values for Segment 5

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
1.164	6.624	16.149	5.758	8.129	25.51117

Rate Constants for Segment 5. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.644	6.667	7.598	0.15	0.229	0	0

Output for Segment 5

Segment starts at JACKSONS CHASE WWTP MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
6.26	0	6.624	16.149	5.758
6.36	0.1	6.621	15.991	5.738
6.46	0.2	6.62	15.834	5.718
6.56	0.3	6.62	15.679	5.698
6.66	0.4	6.622	15.525	5.678
6.76	0.5	6.625	15.373	5.658
6.86	0.6	6.629	15.222	5.638
6.96	0.7	6.634	15.073	5.618
7.06	0.8	6.64	14.925	5.598
7.16	0.9	6.647	14.779	5.578
7.26	1	6.654	14.634	5.558
7.36	1.1	6.662	14.491	5.539
7.46	1.2	6.671	14.349	5.52
7.56	1.3	6.68	14.209	5.501
7.66	1.4	6.689	14.07	5.482
7.76	1.5	6.699	13.932	5.463
7.86	1.6	6.709	13.796	5.444
7.96	1.7	6.719	13.661	5.425
8.06	1.8	6.729	13.527	5.406
8.16	1.9	6.74	13.395	5.387
8.26	2	6.751	13.264	5.368
8.36	2.1	6.762	13.134	5.349
8.46	2.2	6.773	13.005	5.33
8.56	2.3	6.784	12.878	5.311
8.66	2.4	6.795	12.752	5.292
8.76	2.5	6.806	12.627	5.273
8.86	2.6	6.817	12.503	5.255
8.96	2.7	6.828	12.381	5.237

Discharge/Tributary Input Data for Segment 6

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
209.168	2.26	3.13	7.17	26.8

Incremental Flow Input Data for Segment 6

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.175	21.2

Hydraulic Information for Segment 6

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
2.35	275	1.75	0.7

Initial Mix Values for Segment 6

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
210.332	7.168	5.687	0.589	7.972	26.79287

Rate Constants for Segment 6. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.683	3.038	3.569	0.15	0.253	0	0

Output for Segment 6

Segment starts at FRONT ROYAL STP MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)
8.96	0	7.168	5.687	0.589
9.06	0.1	7.158	5.653	0.588
9.16	0.2	7.149	5.619	0.587
9.26	0.3	7.14	5.586	0.586
9.36	0.4	7.132	5.553	0.585
9.46	0.5	7.124	5.52	0.584
9.56	0.6	7.116	5.487	0.583
9.66	0.7	7.109	5.454	0.582
9.76	0.8	7.102	5.422	0.581
9.86	0.9	7.096	5.39	0.58
9.96	1	7.09	5.358	0.579
10.06	1.1	7.084	5.326	0.578
10.16	1.2	7.079	5.294	0.577
10.26	1.3	7.074	5.263	0.576
10.36	1.4	7.07	5.232	0.575
10.46	1.5	7.066	5.201	0.574
10.56	1.6	7.062	5.17	0.573
10.66	1.7	7.058	5.139	0.572
10.76	1.8	7.055	5.108	0.571
10.86	1.9	7.052	5.078	0.57
10.96	2	7.049	5.048	0.569
11.06	2.1	7.047	5.018	0.568
11.16	2.2	7.045	5	0.567
11.26	2.3	7.072	5	0.566
11.31	2.35	7.085	5	0.565

Discharge/Tributary Input Data for Segment 7

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0.05	23.4	3.81	5.236	26.7

Incremental Flow Input Data for Segment 7

Flow (mgd)	cBOD5 (mg/l)	TKN (mg/l)	DO (mg/l)	Temp deg C
0	2	0	7.177	21.2

Hydraulic Information for Segment 7

Length (mi)	Width (ft)	Depth (ft)	Velocity (ft/sec)
0.33	275	1.8	0.6

Initial Mix Values for Segment 7

Flow (mgd)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	DOSat (mg/l)	Temp deg C
210.382	7.085	5.013	0.566	7.974	26.79284

Rate Constants for Segment 7. - (All units Per Day)

k1	k1@T	k2	k2@T	kn	kn@T	BD	BD@T
0.5	0.683	0.182	0.214	0.15	0.253	0	0

Output for Segment 7

Segment starts at CHRISTENDOM COLLEGE MODEL OUTPUT

Total Dist. (mi)	Segm. Dist. (mi)	DO (mg/l)	cBOD (mg/l)	nBOD (mg/l)	
11.31	0	7.085	5.013	0.566	
11.41	0.1	7.051	5	0.565	
11.51	0.2	7.052	5	0.564	
11.61	0.3	7.053	5	0.563	
11.64	0.33	7.053	5	0.563	END OF FILE

APPENDIX D

PERMIT CHANGES AND BASES FOR SPECIAL CONDITIONS

Tabulated below are the sections of the permit, with any changes and the reasons for the changes identified. Also provided is the basis for each of the permit special conditions.

Cover Page
- Content and format as prescribed by the VPDES Permit Manual.

Part I.A.1. **Effluent Limitations and Monitoring Requirements – 0.25 MGD Flow Tier:** Bases for effluent limits provided in previous pages of this fact sheet. Monitoring requirements as prescribed by the VPDES Permit Manual.

Updates Part I.A.1. of the previous permit with the following:
- The $CBOD_5$ limits were adjusted based on current significant figures guidance.
- More stringent Ammonia-N limits were included.
- A footnote was added requiring 85% removal of TSS.
- A footnote was added referencing this facility's coverage under the Nutrient General Permit.
- The E. coli footnote was removed.

Part I.A.2. **Effluent Limitations and Monitoring Requirements – 0.375 MGD Flow Tier:** *New requirement*: Bases for effluent limits provided in previous pages of this fact sheet. Monitoring requirements as prescribed by the VPDES Permit Manual.

Part I.A.3. **Effluent Limitations and Monitoring Requirements – 0.625 MGD Flow Tier:** *New requirement*: Bases for effluent limits provided in previous pages of this fact sheet. Monitoring requirements as prescribed by the VPDES Permit Manual.

Part I.B. **TRC Effluent Limitations and Monitoring Requirements:** *Updates Part I.B of the previous permit.* Specifies both disinfection and effluent limits and monitoring requirements should the permittee elect to switch from alternate disinfection to chlorine disinfection. Required by Sewage Collection and Treatment (SCAT) Regulations and 9 VAC 25-260-170, Bacteria; other waters. Also, 40 CFR 122.41(e) requires the permittee, at all times, to properly operate and maintain all facilities and systems of treatment in order to comply with the permit. This ensures proper operation of chlorination equipment to maintain adequate disinfection.

Part I.C. **Effluent Limitations and Monitoring Requirements – Additional Instructions:** *Updates Part I.C. of the previous permit*. Paragraph added regarding significant digits. Authorized by VPDES Permit Regulation, 9 VAC 25-31-190 J 4 and 220 I. This condition is necessary when a maximum level of quantification and/or a specific analytical method is required in order to assess compliance with a permit limit or to compare effluent quality with a numeric criterion. The condition also establishes protocols for calculation of reported values. §62.1 44.19:13 of the Code of Virginia defines how annual nutrient loads are to be calculated; this is carried forward in 9 VAC 25-820-70. As annual concentrations (as opposed to loads) are limited in the individual permit, this special condition is intended to reconcile the reporting calculations between the permit programs, as the permittee is collecting a single set of samples for the purpose of ascertaining compliance with two permits.

Part I.D. **Pretreatment Program Requirements:** *New requirement.* An industrial waste survey must be submitted within 180 days of the permit's effective date. VPDES Permit Regulation, 9 VAC 25-31-730 through 900, and 40 CFR part 403 require certain existing and new sources of pollution to meet specified regulations.

Part I.E.1. **95% Capacity Reopener:** *Identical to Part I.D.1. of the previous permit.* Required by VPDES Permit Regulation, 9 VAC 25-31-200 B 4 for certain permits.

Part I.E.2. **Indirect Dischargers*:*** *Identical to Part I.D.2. of the previous permit.* Required by VPDES Permit Regulation, 9 VAC 25-31-200 B 1 for all STPs that receive waste from someone other than the owner of the treatment works.

Part I.E.3. **Materials Handling/Storage:** *Identical to Part I.D.3. of the previous permit.*. 9 VAC 25-31-280.B.2. requires that the types and quantities of "wastes, fluids, or pollutants which are … treated, stored, etc." be addressed for all permitted facilities.

Part I.E.4. **O&M Manual Requirement:** *Updates Part I.D.4. of the previous permit.* Required by Code of Virginia 62.1-44.19, SCAT Regulations 9 VAC 25-790, and VPDES Permit Regulation 9 VAC 25-31-190 E for all STPs. Added requirement to describe procedures for documenting compliance with the permit requirement that there shall be no discharge of floating solids or visible foam in other than trace amounts.

Part I.E.5. **CTC/CTO Requirement:** *New requirement.* Required by Code of Virginia 62.1-44.19, SCAT Regulations 9 VAC 25-790, and VPDES Permit Regulation 9 VAC 25-31-190 E for all STPs.

Part I.E.6. **Sludge Management Plan Requirement:** *Updates Part I.D.5. of the previous permit.* VPDES Permit Regulation 9 VAC 25-31-100 P, 220 B 2, and 420 through 720, and 40 CFR Part 503 require all treatment works treating domestic sewage to submit information on their sludge use and disposal practices and to meet specified standards for sludge use and disposal. Technical requirements are derived from the Virginia Pollution Abatement Permit Regulation (9 VAC 25-32-10 *et seq.*).

Part I.E.7. **Licensed Operator Requirement:** *Identical to Part I.D.6. of the previous permit.* The VPDES Permit Regulation 9 VAC 25-31-200 C, the Code of Virginia 54.1-2300 et seq., and Rules and Regulations for Waterworks and Wastewater Works Operators 18 VAC 160-20-10 et seq., require licensure of operators. A class II license is indicated for the current facility and expanded facilities.

Part I.E.8. **Reliability Class:** *Identical to Part I.D.7. of the previous permit.* Required by SCAT Regulations 9 VAC 25-790. Class II status was assigned to this facility on December 14, 1988.

Part I.E.9. **Water Quality Criteria Monitoring:** *Updates Part I.D.9. of the previous permit.* State Water Control Law at 62.1-44.21 authorizes the Board to request information needed to determine the discharge's impact on State waters. States are required to review data on discharges to identify actual or potential toxicity problems, or the attainment of water quality goals, according to 40 CFR Part 131, Water Quality Standards, subpart 131.11. To ensure that water quality criteria are maintained, the permittee is required to analyze the facility's effluent for the substances noted in Attachment A of this VPDES permit.

Part I.E.10. **Treatment Works Closure Plan:** *Updates Part I.D.8. of the previous permit.* Required for all STPs per the State Water Control Law at 62.1-44.18.C. and 62.1-44.15:1.1., and the SCAT Regulations at 9 VAC 25-790-450.E. and 9 VAC 25-790-120.E.3.

Part I.E.11. **Reopeners:**
Identical to Part I.D.11. of the previous permit: a. Section 303(d) of the Clean Water Act requires that total maximum daily loads (TMDLs) be developed for streams listed as impaired. This special condition is to allow the permit to be reopened if necessary to bring it into compliance with any applicable TMDL approved for the receiving stream. The reopener recognizes that, according to section 402(o)(1) of the Clean Water Act, limits and/or conditions may be either more or less stringent than those contained in this permit. Specifically, they can be relaxed if they are the result of a TMDL, basin plan, or other wasteload allocation prepared under section 303 of the Act.

New Requirement: b. 9 VAC 25-40-70 A authorizes DEQ to include technology-based annual concentration limits in the permits of facilities that have installed nutrient control equipment, whether by new construction, expansion or upgrade.

New Requirement: c. 9 VAC 25-31-390 A authorizes DEQ to modify VPDES permits to promulgate amended water quality standards.

New Requirement: d. Required by the VPDES Permit Regulation, 9 VAC 25-31-220.C, for all permits issued to STPs.

Part I.E.12. **Suspension of concentration limits for E3/E4 facilities:** *New Requirement.* 9 VAC 25-40-70 B authorizes DEQ to approve an alternate compliance method to the technology-based effluent concentration limitations as required by subsection A of this section. Such alternate compliance method shall be incorporated into the permit of an Exemplary Environmental Enterprise (E3) facility or an Extraordinary Environmental Enterprise (E4) facility to allow the suspension of applicable technology-based effluent concentration limitations during the period the E3 or E4 facility has a fully implemented environmental management system that includes operation of installed nutrient removal technologies at the treatment efficiency levels for which they were designed.

Part II CONDITIONS APPLICABLE TO ALL VPDES PERMITS. VPDES Permit Regulation 9 VAC 25-31-190 requires all VPDES permits to contain or specifically cite the conditions listed.

DELETIONS

Tabulated below are the sections of the previous permit that were deleted and the basis for this action.

Part I.D.10 **Instream Monitoring**: The requirement to perform instream monitoring has been fulfilled.